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Self-Exciting Low-Frequency Alternator.

While the simple type of alternator with a commutator is not self-exciting, if two such simple machines are rigidly coupled together, with the armatures in electrical space quadrature and the field coils subjected to electromotive forces in time quadrature, then the electromotive force generated at the armature brushes of each machine could be used to supply the current to the field winding of the other machine, and the combination would operate as a self-exciting generator unit. At any given speed the frequency would have a value such that the rate of change of the field flux through the field winding generates therein an e.m.f. (counter) equal to the e.m.f. generated at the commutator by the motion of the armature through the same value of field flux (of the other machine). Assume that the effective turns on the armature are equal to those on the field core and for simplicity consider a two-pole model; at "synchronous speed" the speed-generated e.m.f. at the commutator is equal to the transformer e.m.f. at the field winding. Thus it may be said that when the two armatures and field windings are electrically interconnected but mechanically separated, the frequency bears to the speed directly the ratio of the armature turns to the field turns.

An article by Mr. G. Faccioli on page 525 of this issue gives an interesting account of a self-exciting alternator in which the frequency is much below the value which would be obtained by driving an ordinary alternator having the same number of poles at the same rotative speed, and is essentially different from the value found for the self-exciting alternator discussed above. In making a superficial examination of the machine, of which the circuit diagram seems to be that of two interconnected mutually-excited direct-current generators, two questions are likely to arise: First, why does not the generating unit deliver direct instead of alternating current? and, second, what determines the frequency of the delivered current? As to the first question, a little study will show that the combined machine could not operate as a direct-current generator because the circuits are so interconnected that the e.m.f. generated by cutting through the residual field flux at certain brushes on the armature is in a direction to send current through the opposite pair of field coils in a direction to produce a flux which will cause the speed-generated e.m.f. due thereto to produce a current which tends to decrease the residual magnetism; if it tended to increase the residual magnetism, the machine would, in fact, build up its magnetism as two superposed mutually excited direct-current machines. Thus, if the terminals of one pair of brushes of the machine are interchanged one with the other, the machine will in fact become a direct-current generator.

In regard to the ratio of the speed to the frequency, it will be noted that in the type of generator in which the two armatures are mechanically and electrically combined in one, the transformer action of each field flux in the armature winding will have its maximum effect in mechanical line with the opposite pair of brushes. With a unity ratio machine (equal effective armature and field turns) the transformer action of one flux is equal to the speed action of the other flux at synchronous speed.

At positive synchronism (direction of rotation being that of the revolving field), the two e.m.f's are opposite in phase and the resultant is zero; but at negative "synchronism" the two have the same electrical time phase and the resultant is the arithmetical sum of the two. In order for the resultant armature e.m f. to be equal to the field e.m.f. with a unity ratio machine, the speed must be double synchronism in the positive direction. In general it may be stated that frequency is equal to the speed multiplied by the armature turns and divided by the sum of the armature and the field turns, as pointed out in the article. Since two fluxes in electrical space quadrature and electrical time quadrature combine to produce a synchronously revolving field, it is evident that the time phase position of the e.m.f. between any pair of brushes on the rotor and the e.m.f. required to produce a certain flux on the stator depends directly upon the electrical space position of the brushes on the commutator; and the exact phase for the exciting e.m.f. can easily be found by shifting the brushes into the proper positions. Thus the minor modifying effects, including the time phase displacement between the field current and the flux produced thereby, which were neglected in the outline discussion above, can be taken into account by shifting the brushes through a certain angle which depends for its value upon the resistance of both the field and the armature winding and is modified by the magnetic leakage and the core losses. The minor effects neglected above require the armature e.m.f. to be larger than found from the ratio of turns, so that in order to deliver a certain frequency the speed must be higher than indicated by the ratio of turns.

Combined Lighting and Railway Plants.

The number of lighting and railway plants operated in connection with one another is yearly on the increase. It is a matter of interest as well as of possible profit to inquire as to some of the usual results of such consolidations of railway and lighting companies. In a combined railway and lighting plant, is either department of the business likely to suffer by neglect, and if so, which department? In most cases combined railway and lighting plants do better financially and give better service than before the consolidation took place. Nevertheless, it is pertinent to ask whether there are not some tendencies under consolidation for one department to be looked upon as a side issue and not developed as fully as it should be. It cannot be denied that this does occur to a certain extent in many cases and is one of the things that should be guarded against by the owners and managers of such properties. The general manager of a consolidated property of this kind is usually a man who has received his training either as a railway man or as a lighting man. He is rarely equally versed in both branches. If he is a street railway man, he is very likely not to appreciate the needs of the lighting business as well as he does those of the railway business, and the lighting end of the business consequently suffers. If, on the other hand, he has been trained entirely in the lighting field, the addition of the management of a small street railway is apt to be looked upon as a nuisance and a rather unprofitable one at that. If the company is a small one, the lighting end of the business is usually the most profitable and consequently the management is usually in the hands of a lighting man. If the company operates in a large city, the street railway being the biggest end of the business, the lighting becomes secondary and the general management of the company generally is in the hands of a street railway man. It takes very good judgment indeed upon the part of the general manager of such a property to avoid making one department or the other too much of a secondary consideration.

It might be supposed naturally that what has been said about the management of individual companies would not apply to syndicates or holding companies which control a large number of properties in various cities doing both railway and lighting business. It might be thought that these syndicates, with the abundance of talent of all kinds at their command, would not allow either the lighting or railway departments in any of their properties to suffer. As a matter of fact, the management of such holding companies and syndicates seems in many cases to be fully as one-sided as that of smaller companies. Some syndicates handle lighting properties in an excellent manner and make but indifferent work of a railway when they happen to secure one. Other syndicates are notably strong in railway operation and weak in the conduct of their lighting properties. Some railway syndicates have no desire to acquire lighting properties and will get rid of them as soon as possible should they be secured in the course of trade. The foregoing has been mainly a recital of observed facts. The only conclusion of value to be drawn is, of course, that a one-sided management is especially to be guarded against in a combined railway and lighting plant.

Installment Payment for Residence Wiring.

The plan of wiring residences for electric light and taking payment on the installment plan seems never to have been very extensively adopted in this country, although some companies will make this concession if requested. With many gas companies ranges are sold regularly on the installment plan and undoubtedly this results in much more general use of gas ranges where this is done than would otherwise be the case. The comprehensive scheme of the Cleveland Electric Illuminating Company for the wiring of residences on the installment plan was described by Mr. M. E. Turner before the recent Ohio Electric Light Convention. Because of its unusual interest, both to central station companies and to wiring contractors, the contract and schedule are given elsewhere in full, which have been very carefully worked out after a number of months preliminary experience. The general scheme is for the company's solicitors to secure these contracts and turn them over to local contractors selected by the company, the company doing no wiring itself. A rather singular result of the application of the plan is that a much more expensive class of houses has been wired under it than was anticipated. The cost of wiring is unquestionably the greatest hindrance a central station company has in extending its business among old residences in a large city. If it becomes a regular practice to spread out payment for wiring over a number of months, it is certainly reasonable to suppose that with proper solicitation an immense increase in residence business can be secured over and above that which would naturally come in. As we have many times pointed out, a residence load with a number of customers per block is one of the best kinds of lighting load a central station can secure.

Shop and Factory Lighting.

We doubt whether many realize the revolution in factory work at night which is being brought about by modern electric illuminants. The day when factory superintendents must figure on a considerably lower rate of production during working hours after night than during daylight is rapidly coming to a close as far as insufficiency of artificial light influences the problem. Probably very few ever stop to consider what an important influence the lighting of a shop or factory has on the possible rate of work

of all the workmen. Even in what would have been considered a splendidly lighted shop of a few years ago the general artificial illumination was so poor that whenever a workman left the immediate vicinity of his little individual incandescent lamp or gas jet he was to a certain extent groping. Thoroughly good illumination is essential to prompt, unhesitating movements, besides which the psychological effect of a well-lighted factory on the workmen is important. Good artificial illumination of a factory or work shop to-day requires that there shall be such a flood of light that daylight conditions are approached. There must, as far as possible, be an absence of shadows around machinery and under tools. Such effects can only be produced by having light coming from a number of sources and having those sources provided with large light-emitting surfaces either directly or indirectly by reflection. The success of vapor tube lighting is due largely to the large light-giving surfaces of the tubes. With arc lamps similar effects have been produced by the use of very large reflectors and diffusing globes and whitened ceilings and walls. Anything that adds to the surface from which the light is received improves the illumination by reducing shadows.

INCANDESCENT LAMP DEVELOPMENT.

We have already adverted at different times. both editorially and descriptively, to the progress recently made in the improvement of incandescent lamp filaments. There are now four distinct new filaments in use, although as yet only to a very limited extent. These are the graphitized carbon filament, recently developed by a treatment of ordinary filaments under a specific high-temperature process, and the filaments of the rare metals osmium, tantalum and tungsten. The graphitized carbon filaments are found to be practically workable at a specific consumption of 2.5 watts per mean horizontal British candle, and under this condition their useful duration of life, that is, their period of active service to 80 per cent of their initial candle-power, is quite equal to that of the existing standard 3.1-watt-per-candle ordinary carbon filament. These lamps are already being made in relatively small quantities, and it is expected that in the course of a year or so they will be available in considerable quantities. They are, however, likely to be somewhat more expensive than the present standard lamp, although some believe that this difference in cost will ultimately disappear.

Such carbon filament lamps as have already made their appearance in standard types are not 16-cp, 40-watt lamps, but 20-cp, 50-watt lamps. That is, they consume the same power as the present standard 50-watt lamps, but give 25 per cent more light for the same power. This means that when such new lamps become available the consumer receiving them will probably receive the benefit of 25 per cent more light for the same meter registration and monthly bill. At some future period it is possible that 16-cp lamps and 8-cp lamps will be made consuming about 40 and 20 watts, respectively, or giving the same light as the present types at a reduction in current consumed; but if this change is effected it will probably come at a later period, or after the general introduction of the new 50-watt lamps.

The efficiency of the graphitized carbon filaments has, however, been already surpassed by the other metallic filaments above mentioned, and particularly by the tungsten filaments. Tungsten is a well-known metallic element not nearly so expensive as tantalum or osmium. It is very hard, brittle and difficult to draw into wires. Its fusing temperature is very high and is stated to be in the neighborhood of 2,500° C. Tungsten filament lamps are now being manufactured in Germany and Austria by several firms and tests of these lamps have been made both by the Charlottenburg Reichsanstalt and the electrotechnical laboratories of Vienna.. These tests are mutually corroborative, and indicate a consumption of about 1.1 watt per mean horizontal hefner, which means about 1.23 watt per mean horizontal British candle. The useful life of these lamps is remarkable, about 1,000 hours being claimed for them. According to recent announcements tungsten lamps are also being manufactured in small numbers in this country by a different process. These lamps show a consumption of 1¼ watt per mean horizontal candle and have a useful life of 700 hours or more.

It will no doubt be some time before such tungsten lamps can be generally introduced. The number of carbon filament lamps installed in the United States is so large that years must elapse before a complete change can be made to a new type. Moreover, the tungsten lamp is sure to be more expensive than the carbon lamp, and its price has not yet been announced. This difference in expense will tend to retard the substitution of tungsten filaments for carbon filaments. The reduction in consumption from 3.1 to 1.25 watt per candle is, however, so sweeping that even at a considerable increase in first cost, the tungsten lamp must ultimately prevail. The ordinary arc lamp cannot compete with such a lamp in efficiency of illumination, and it would seem that only flaming arcs could hold their own in competition with them. Remarkable features of the tungsten lamp are its relative freedom from blackening, its great duration of useful life and its relative insensitiveness to sudden variations of voltage. According to Reichsanstalt tests, the efficiency of certain tungsten lamps was only about 5 per cent less after 1,000 hours than at the start, and the candle-power at constant voltage only about 9 per cent less. Their candle-power is so well sustained that there is no smashing point. The filaments usually break before the candle-power falls to 80 per cent, and the useful life is thus the ultimate life.

The only defect which tungsten filaments are stated to possess is fragility. They are even more fragile than tantalum filaments and liable to suffer from vibration, particularly after having been in use. For this reason the lamps thus far made are only adapted for use in a vertical position; that is to say, with the tip pointing either vertically down or vertically up. Like tantalum filaments, they have to be made very long and thin for service on 115-volt mains and they are entirely unsuitable for use on 230-volt mains except in large candle-powers. Lamps consuming 50 watts for 40 candles are made up to 130 volts, but it is said that there would be considerable difficulty in making 16-cp lamps for such voltage and that 8-cp lamps are at present out of the question for such voltage. It is, of course, early to speak of the requirements of the tungsten lamp, and it may be that the future will lead the way to yet higher efficiencies and also to greater mechanical strength. But on the supposition that no substantial improvements in these directions are obtained, it would seem as though in future years, when these lamps become generally available, we should have to revert to 50-volt alternating-current mains, or to 5-wire secondary systems of 230 volts between outers, in order to permit of securing low candle-power lamps of tungsten with the economy already attained. Since the amperes per lamp would then be on two-wire systems of 50 volts, only about half what it is now, with carbon filaments at 120 volts, the lower voltage would not involve an increase of secondary circuit copper for a given number of lamps.

Electrical Meetings at Schenectady.

Promise of great activity on the educational and social side of Schenectady was given at a well-attended meeting of the local branch of the American Institute of Electrical Engineers, held on Saturday evening, September 8. The gathering, which took place at the fraternity house of Alpha Delta Phi on Union College campus, was in the nature of an informal smoker, and plans were discussed for the ensuing year.

During the evening addresses were made by Prof. C. P. Steinmetz, of the General Electric Company and Union College, and by David B. Rushmore, the chairman of the branch. The speakers outlined the suggested programme for the winter, which includes not only the regular monthly meetings as heretofore, but a course of Saturday evening lectures as well. Already over thirty prominent engineers, many of them from outside of Schenectady, have accepted the society's invitation to speak.

Prof. Steinmetz, in his remarks, recalled the early days of the General Electric Company, so well remembered by the older engineers, when a close acquaintanceship and exchange of ideas were possible between the experienced men and the beginners. The immense growth of the business has so segregated the members of the different departments that this intercourse is no longer practical, a condition greatly regretted by those who appreciated the advantages derived on both sides from the former closer relationships.

It is, therefore, intended to make the lectures not only instructive, but by this means to furnish an opportunity for social gatherings where acquaintances can be made between the local engineers, the students in the college of Schenectady and Troy and all others interested in electricity and its applications.

In order to stimulate interest in these meetings, free trips to New York to attend the monthly meetings of the national association of the American Institute of Electrical Engineers, will be given to those who take a conspicuous part in the discussions, or otherwise contribute to the success of the branch. A neat prospectus outlining the proposed work was distributed at the gathering Saturday evening, and the general expressions of approval with which the plans were received leave no doubts as to the success of the undertaking. Mr. E. B. Merriam, of the General Electric Company, is chairman of the membership committee, and is already getting busy enrolling new members. A special membership, with dues one-half the regular branch dues, is proposed for all men in the General Electric testing department, the American Locomotive Works testing department, Union College and the Rensselaer Polytechnic of Troy.

The Proposed Municipal Trolley for Seattle.

Mr. Jacob Furth, the president of the Seattle (Wash.) Electric Company, has been interviewed as to the municipal street railway system that is proposed for that city. He made some interesting comments, on the specific and general questions, that may be quoted as follows: "I am somewhat embarrassed in expressing my views by the fact that I am the president of the Seattle Electric Company. However, those who know me are aware that I am able to speak for myself as a citizen and taxpayer, irrespective of the interests which I also represent. Without discussing the general question of municipal ownership, I do not think that the city can afford at this time to incur the indebtedness necessary to construct and operate the proposed system. The city has many urgent needs. We have not enough sewers, our water supply is inadequate, the municipal building must be completed, our fire protection in the business district is wholly insufficient. Besides these there are public improvements, such as grading and regrading streets, which must be carried forward without delay, and while it is true that the greater part of the most of these will fall upon the property affected, yet the immediate burdens on owners will be so great that the city should not add to them by unnecessary demands. This consideration, in my opinion, should be controlling upon the citizens of Seattle at this time.

"As for the Seattle Electric Company, it is waiting to see what the voters do at the special election. The company came into the field here when there were half a dozen or more independent and in many cases competing companies, most of which were in the hands of receivers. The service was poor. There was no transfer system. The equipments were run down. The company instituted a better service, replaced the worn equipment, built new lines, have general transfers, and has done its utmost to keep pace with the growing demands of the city. In the outlying districts it has been a leader of population, not a follower. By reaching out to localities where land prices are low, often regardless of the fact that the new lines in the beginning were not profitable, it has made it possible for persons of moderate means to own their own homes in the suburbs and to get to their work conveniently, and has aided and made possible the development of large districts which otherwise would have remained unimproved. The company has prospered by this policy, and its policy in the future will be as it has been in the past.

"Some of the criticism of the company's service, in respect to overcrowding of cars, is justified. It has not been any more possible for the company to foresee all the extraordinary growth of the city than it has been for the city authorities, or men engaged in other enterprises. Orders for new cars and other equipment have to be given practically a year in advance, and often before the expiration of six months after the order has been given it has become apparent that the provision was not sufficient. But this has been true in all departments of the city service. It has been true of the water department, of the sewer department and in fact of all affected by the city's growth.

"Stone & Webster are the owners of about thirty properties in various cities. Their experience, resources, opportunities for purchase in large quantities on favorable terms, as well as their broad experience and liberal policy, have combined to render the Seattle service as nearly what it should be as the extraordinary conditions which I have mentioned would permit. The president and manager here have been accorded the most complete power in all matters of local concern—the business policy of the company is as much dictated by local conditions as if all of its stock were owned in Seattle."

Hydro-Electric Development in Mexico.

The utilization of the water power afforded in various parts of Mexico for the generation of electrical energy has shown wonderful progress during the last year. Many concessions of this character have been granted by the federal government and several large hydro-electric plants have been established. These plants have served the purpose of aiding materially in the mining and manufacturing development of the particular sections in which they are situated.

The government granted recently a concession to Messrs. Norcross and Taylor, of Mexico City, for the installation of a hydro-electric plant near Orizaba, in the State of Vera Cruz. The water power will be obtained from either the Salado River or from the Nogales Lagoon. The concession also carries with it the right to build and operate electric transmission lines and all appurtenances necessary to the construction and operation of hydro-electric works. The plant must be completed and in operation within seven years. The concessionaires have deposited $5,000 in bonds of the consolidated public debt in the national treasury as a guaranty that they will fulfill the obligations assumed under the concession.

William J. Storms, a wealthy American business man of Victoria, State of Tamaulipas, Mexico, is arranging to establish a series of hydro-electric plants on the Rio Blanco in that State. He has applied to the federal government for a concession for the proposed enterprises. In his application for the concession Mr. Storms says that he intends to utilize the falls in the Rio Blanco. These falls would yield from 8,000 hp to 15,000 hp. In order to utilize this to the best advantage a series of plants are to be erected along the course of the stream through the canyon, it being impracticable to concentrate them all at one fall. It is planned to transmit the electrical energy afforded by these generating plants to the cities of Monterey, Victoria, Linares, Mon-

temorelos and other towns of that section. Monterey is the principal manufacturing city in Mexico. It has many large industries, such as smelters, iron and steel works, nail factory, etc.

Juan de Velasco and Carlos Bello, of Mexico City, have acquired title to a waterfall on the Cantarranas River in the State of Puebla. They will install a large hydro-electric plant at the fall and transmit the power to Atlixco, which is an important industrial center.

Engineer A. B. Adams, of Mexico City, who has large mining interests in the State of Guerrero, has applied to the federal government for a concession to install a large hydro-electric plant on the Balsas River, near the town of Balsas. The project is of mammoth proportions, and it is said that the financial arrangements for its consummation have been made. It is planned to construct transmission lines from the generating plant to the various industries of that section and to the mines. The main transmission line will be built to Mexico City. There are many large sugar mills in the vicinity of the proposed plant and these will be supplied with electric power. Engineer Adams has had made a preliminary survey for the plant.

The hydro-electric plant that is being built near Mexico City for the purpose of furnishing Tepic with power and lights will be placed in operation in a few days. The plant will also supply cotton mills and other industrial concerns at Tepic with electric power.

The Coal Production of the United States in 1905.

According to the report of Edward W. Parker, Statistician of the United States Geological Survey, which is now in press, the production of coal in 1905 amounted to 392,919,314 short tons, having a value at the mines of $476,756,963, surpassing in both quantity and value all previous records in the history of the country. Compared with 1904, when the production amounted to 351,816,398 short tons, valued at $444,371,021, the output in 1905 exhibits an increase of 41,102,943 short tons, or 11.7 per cent in quantity, and of $32,385,942, or 7.3 per cent in value. Prior to 1905 the maximum output of coal was obtained in 1903, when the production amounted to 357,356,416 short tons, valued at $503,724,381, compared with which the record for 1905 shows an increase in production of 35,562,925 short tons, and of $26,967,418. The high value recorded in the statistics for 1903 was due to the somewhat abnormal inflation of prices, caused by the shortage of fuel supplies, which resulted from the strike in the anthracite region of Pennsylvania in the preceding year. The lower values in 1904 as compared with 1903 were simply a return to normal conditions, but the decline in 1905 was the result of a production in excess of market requirements, unusually large as they were.

Of the total production in 1905, 69,339,152 long tons (equivalent to 77,659,850 short tons) were Pennsylvania anthracite, with a value at the mines of $141,879,000. The total production of bituminous coal and lignite was 315,259,491 short tons, valued at $334,877,963. The production of anthracite coal in Pennsylvania in 1905 was 4,020,662 long tons (or 4,503,151 short tons) more than that of 1904, while the increase in the production of bituminous coal and lignite was 36,599,882 short tons. A portion of these increases in both anthracite and bituminous production was due to the efforts of operating companies to provide a supply of fuel in anticipation of a suspension of mining in April, 1906, when the wage scale agreements in the organized coal producing States and the award of the Strike Commission in the anthracite region of Pennsylvania would terminate.

It is a fact worthy of note that the total increase in the production of coal in the United States in 1905 over 1904 was larger than the production of France in 1904, or of the production of any other foreign country except Great Britain, Germany and Austria-Hungary, and was almost equal to that of the last mentioned. The total production of this country last year was nearly 50 per cent larger than that of Great Britain, which until 1899 was the leading coal producing country of the world, and was more than double that of Germany. Another interesting fact presented in the statistics of the production of coal in the United States is that in each decade the output has been practically doubled. Up to the close of 1865 the total production had amounted to 284,890,055 tons. In the decade from 1866 to 1875, inclusive, the production amounted to 419,425,104 tons, making the total production up to the close of 1875, 704,315,159 tons. In the following decade, from 1876 to 1885, inclusive, the production amounted to 847,760,319 tons, something more than double the total production up to the beginning of that decade. At the close of 1885 the total production amounted to 1,552,075,478 tons, and the production for the 10 years ending with 1895 was 1,586,098,641, and the total production to the close of 1895 amounted to 3,138,174,119 short tons. In the decade ending December 31, 1905, the total production has amounted to 2,832,599,452 short tons and the grand total from the beginning of coal mining has amounted to 5,970,773,571 short tons.

Of the total amount of bituminous coal produced in 1905, 103,396,452 short tons were mined by the use of mining machines, as compared with a machine-mined product in 1904 of 78,606,997 short tons. The number of mining machines in use increased from 7,663 in 1904 to 9,184 in 1905, due largely to the adoption of electricity.

The total number of men and boys employed last year in the coal mines of the United States was 626,174, against 593,693 in 1904. Of the total number employed in 1905, 165,406 were in the anthracite mines of Pennsylvania, and 460,768 were employed in the bituminous coal mines. The average number of days worked by the anthracite miners was 215, while the bituminous miners made an average of 211 days.

Electricity in Cotton Manufacturing.

The National Association of Cotton Manufacturers held its semi-annual meeting at the Hotel Champlain, on Lake Champlain, September 12 and 13. As usual, a number of interesting technical papers were presented, including one on the Curtis vertical turbine by Mr. C. B. Burleigh, and one on practical experiences in electrical driving by Mr. John A. Fernley, of New Bedford, Mass. The first paper dealt with the historical development of the turbine, and its specific technical features as embodied in the General Electric type, and then enumerated some practical examples that should commend it for adoption in textile mills. While some of the data are familiar, the subjoined review may be of interest to many readers.

The Thirteenth and Mt. Vernon Streets station of the Philadelphia Rapid Transit Company is located at such a distance from the water necessary for condensing that the engines at this station had always been operated non-condensing.

At this plant there are installed four 1,500-hp and one 2,200-hp Wetherell Corliss engines. The 1,500-hp engines are each direct-connected to a generator, developing an average of 2,000 amp. at 575 volts. It was found desirable to increase the capacity of this station and the matter was carefully considered by the engineers, and it was finally decided to install an 800-kw low-pressure Curtis turbine, taking steam at approximately one pound above the atmosphere and expand it to 28 in. of vacuum obtained by the installation of a surface condenser and cooling tower.

The turbine generator being connected to the same bus-bars in multiple with the generator driven by the engine from which the turbine received its energy, obviated the necessity for equiping the turbine with any governor, as its regulation was perfectly automatic from the fact that should the voltage on the turbine tend to rise it would result in the load on the turbine increasing, and the load on the engine would be correspondingly lessened and this would reduce the volume of steam passing through the engine and consequently the amount supplied to the turbine and it would immediately tend to drop back when a larger proportion of the work would be transferred to the engine set, and this would require more steam, which it would deliver to the turbine, thus maintaining an absolute balance.

These favorable conditions resulted in the installation of a peculiarly simple form of turbine consisting of nothing as far as the steam unit is concerned other than the shell, wheels and expanding nozzles, omitting the governor and admission valves, with the result that the capacity of the station was increased ap-

proximately 66⅔ per cent, at an expense of less than half of that possible by any other method.

Considering this one unit by itself, the original installation probably cost between $100 and $150 per kilowatt, including all costs, and the increase in capacity of 66⅔ per cent, or not more than half this amount.

Viewed from an operating standpoint, outside of the interest and depreciation on the addition it did not cost the Philadelphia Transit Company one dollar more to put 2,800 kw into their switchboard than it formerly cost them to deliver 2,000 kw.

That is to say, this additional 800 kw did not call for the consumption of an additional pound of coal and the simplicity of the added apparatus was such that it required no additional labor.

Another similar Curtis turbine adaptation is that made by the Scranton (Pa.) Railway Company, who have installed four Corliss simple non-condensing engines, direct-connected and belted to generators, the combined normal capacity of which is 2,300 kw. The conditions of operation are such that while the average output of the plant is 1,500 kw, there are times when the plant is seriously overloaded for short periods.

These four engines exhaust to the atmosphere through a common exhaust header from the top of which is a pipe open to the atmosphere. A pipe is taken from this common exhaust main to supply steam to a 500-kw Curtis turbine similar to the one previously described, the steam expanding from the atmospheric pressure to 28 in. of vacuum, which is produced by a surface condenser, circulating water being obtained from the Lackawanna River 450 ft. distant and raised about 54 ft. to the condenser head. This turbine will develop its rated output with a steam consumption of about 38 lb. of steam per kw-hour, approximately 19,000 lb. of steam per hour. The engines at 30 lb. per horsepower per hour and developing 3,000 hp will deliver 90,000 lb. of steam per hour, so it will readily be seen that as the load increases there is ample margin for further increase in this same line.

The conditions of operation in this case are similar to those in the former case, in that the generators are multiplied on common buses and regulation is wholly accomplished electrically, thus obviating the necessity of mechanically governing the turbine.

But you may say that the above-described conditions are not ideal conditions, or conditions of operation in an ideal power plant to the extent that a large proportion of well-designed power plants are so located that they can be economically operated condensing. But the above device converts a plant already installed, into one of greater capacity at a minimum first cost as well as cost of maintenance.

The conditions under which a Curtis low-pressure turbine can be installed with benefit to the user in connection with a condensing steam plant, while not productive of so large a percentage of increase, are such as will result in an increase of from 20 to 25 per cent under these conditions, and at lower cost, as in this case we have only to consider the cost of the turbine and the expense for the apparatus for providing the additional circulating water made necessary by the benefits derived from increasing the vacuum one or more inches which the use of the turbine makes possible.

In this case the additional power, or improvement in economy obtainable, will largely depend upon the characteristics of the engine or engines under consideration.

The principal merit of the low-pressure turbine used under these conditions will be that it will increase the maximum output obtainable from the power plant, without increasing the boiler plant, and consequently entails but small increase in investment.

A 5,000-kw engine plant was recently investigated where the maximum amount of steam available from the boilers for operation is about 120,000 lb. per hour, and this when applied to the engine with a vacuum of 27 in. was capable of operating at about 22 per cent overload. In this case the conditions of the engines were such that the addition of a low-pressure turbine would increase the maximum overload obtainable to 43 per cent with the same vacuum of 27 in. With a vacuum of 28 in., the maximum overload obtainable would be increased to 53 per cent. Thus with a vacuum of 28 in. the increase of power amounted to 31 per cent without additional fuel consumption and the maximum output of the plant was increased by a similar amount.

If in this case more steam were available it would pay to use a larger low-pressure turbine and a much higher maximum could be obtained without loss in steam economy. I have in mind another case, a textile mill which is electrically operated having two generators of 1,600 and 2,300 kw capacity respectively. Each generator is direct-connected to a horizontal cross-compound engine.

The load conditions at the present time are such that the all-day output is 3,000 kw. This necessitates the continuous operation of both units, and as they are synchronized on common buses they both operate at an uneconomical point.

The installation of a 500-kw low-pressure turbine, so arranged as to take steam from the exhaust of either or both engines, would result in their being able to carry the entire load from the larger unit, or if operated in series, with the smaller unit, would make it a relay for the larger unit practically of equal capacity, or used in conjunction with both units, would increase the total plant output by 500 kw without increasing the fuel consumption.

When used in conjunction with the larger unit to carry the whole load this unit, as a whole (considering the turbine as an additional low-pressure cylinder), would result in better economy than would result from a triple-expansion engine and would represent a vast saving over the operation of the two units operating at poor load factors.

Mr. Burleigh cited also the satisfactory results with the installation in the plant of the Nashua Manufacturing Company, and added that none of those who have ever used them have ever added to their capacity by the installation of reciprocating units, while seventy users have purchased a second, twelve have purchased two additional units, eight have added three units, six have added four units, three have added seven units and one concern has from time to time in the last three years purchased fourteen units. In other words, approximately 250 concerns have purchased Curtis vertical shaft turbines. One hundred of them, or 40 per cent, have placed further orders for the same apparatus.

Mr. Fernley, in his paper, discussed several practical points of operation. One of these is the necessity of keeping the motor clean. He said:

"It will readily be seen that in a room where there is a large amount of dust and cotton fibres in the air such as is found in card rooms, etc., that this air-gap will soon become more or less filled with the same, and thus in a measure insulate the field from the armature and give the current an added resistance to overcome before doing the work of operating the machinery. To overcome this it is necessary to have the motors thoroughly cleaned out, by blowing out this accumulation of dust and dirt. The time between such blowing off depends entirely upon the position of the motor, but I incline to the idea of giving it a good cleaning at certain stated intervals rather than to simply clean it a little every day.

About the only effectual way to get this lint and dust from the interior of the motor is to install a compressed air system; the pump for which may be placed in the engine room basement or other convenient place, and to carry this air by means of pipes to every motor in the mill, placing a valve on each side of the motor. Select some man to attend to this work in the different rooms and provide him with about six feet of very strong rubber hose, capable of withstanding a pressure of about 55 lb. Have it understood that the air must be applied to each side of the motor more than once, blowing from one side and then the other alternately. The reason for this is because there are so many crevices and angles in a motor that blowing from one side alone would only distribute the cotton dust around the inside of the motor."

Mr. Fernley exhibited some curve charts showing the economic advantages of electric drive.

Chinese Names and Telegrams.

Chow-Wan-Pang, director of the Imperial Chinese Telegraphs, has written to telegraph officials in this country with regard to telegraphy in China and the attempt now being made to secure uniformity in the spelling of Chinese city names. He says:

"The development of telegraphs and posts in the Empire of China has necessitated that a uniform system of romanization of Chinese city names should be adopted, and for this purpose a special committee was appointed. This committee consisted of Toatai Chow Wan-Pang and Mr. F. N. Dresing, of the Imperial Telegraphs; Messrs. H. B. Morse and W. Bright, of the Imperial Customs; Count de Galembert and Mr. H. W. Brazier, of the Imperial Posts, and Mr. W. F. Tyler, Imperial Chinese Coast Inspector."

As a result of the work of the committee, it is stated, a uniform spelling system has been adopted, and will in future be applied to all Chinese names. The names of several Chinese telegraph stations have already been altered. The uniform romanization of the names of Chinese towns will be a great convenience to Americans and other foreigners who have business relations with the Celestial Empire. The Chinese Government adopted the telegraph system before it allowed the building of railroads because the officials recognized in it an important factor for the maintenance of order in the interior of the country. Today there are about 4,000 miles of railroads and 15,000 miles of telegraphs in the 4,277,170 square miles of territory which comprise the Chinese Empire. All telegraph forms are inscribed in Chinese and English.

The Chinese officials are as particular in their telegrams as they are in every other line of their business. Foreigners make mistakes in the names of towns and provinces and then throw the blame, if the message goes astray, upon the officials. Owing to the similarity of names it is easy for any one but a Chinese to make an error which may send a telegram all over the country before it arrives at its proper destination. It is, however, certain to arrive finally, even if a year is occupied in the journey. The Chinese are very painstaking and methodical, and time with them is usually no object.

Names of towns like Chank-Lo, Chang-Loh, Ho-Chow, Hoh-Chow, Ngan-Tin, Ngan-Ting, Ning-Yang and Ning-Yuan are specimens of what has to be contended with in China. It is alleged that Hongkong business men who have an extensive correspondence with merchants in the interior frequently sit for hours in the billiard room of the Hongkong Hotel trying to think out whether the name of a town to which they wish to wire should read "Ling-tin-Ling" or "Ting-yin-Ting."

The Late James Dredge.

There recently passed away in the person of Mr. James Dredge one of the fine types of Englishmen so much appreciated on this side of the Atlantic. Succeeding in 1870 that extraordinarily brilliant and versatile American genius, Zerah Colburn, as co-editor with Mr. William H. Maw, of *Engineering*, he watched the growth of that journal from its fourth to its fortieth year. An excellent preliminary training, together with a clear head, sound judgment and remarkable capacity for work, contributed not a little towards making that weekly the leading journal of the engineering profession.

Recognizing the importance of international expositions for the spread of technical knowledge, Mr. Dredge went to the "Weltaustellung" of Vienna, 1873, accompanied by a number of specialists who wrote for his paper several series of articles that attracted widespread attention. The year 1876 found him at our "Centennial" in Philadelphia and 1893 at the "World's Fair," Chicago, where he held the position of British Commissioner. Throughout his life Mr. Dredge continued to study those mammoth collections of the products of human industry; and for the eminent services which he rendered France made him an officer of the Legion of Honor, while Belgium conferred upon him the Order of St. Michael and St. George.

To electrical engineers Mr. Dredge is best known by his voluminous work on "Electric Illumination," published in 1885, with the co-operation of Prof. S. P. Thompson, Conrad W. Cooke and Dr. M. F. O'Reilly.

At his beautiful London home on Clapham Common, Mr. Dredge received his friends with great cordiality and entertained them with characteristic hospitality. It would be interesting to note the number of our countrymen who went to Clapham Lodge to discuss plans and projects. Among them we may mention only Alexander L. Holley, who was so intimately connected with the early improvements in the manufacture of steel. When in 1890 a bronze bust was erected to his memory in Washington Square, New York, it was Mr. Dredge whom the committee selected to deliver the inaugural address; and those who attended Chickering Hall on October 2 of that year will recall the imposing physique of the orator and the noble tribute of appreciation which he paid to the sterling qualities of his life-long friend. Mr. Dredge was born at Bath July 29, 1840, and died in London in his 67th year, August 15, 1906.

Street Arch Illumination at Connellsville, Pa.

Connellsville, Pa., the center of the coke region of Pennsylvania, and said to produce some of the best coke in the world,

FIG. 1.—COAL AND COKE ARCH.

has just been celebrating its one hundredth anniversary, with exercises and festivities of various kinds. The decorations included the coal and coke arch shown herewith in Figs. 1 and 2, the arch being erected by the H. C. Frick Coke Company

FIG. 2.—COAL AND COKE ARCH ILLUMINATED.

in honor of the occasion. A wooden substructure was first built, and the coal and coke fastened thereon, like the stone skin of a steel frame building. The coal pillars at each corner were of coal taken from the four principal properties of

the district—Leisenring 1 and 2, Davidson and Potter. The coke forming the four parts of the arch was also from the same mines. To complete the work as shown required thirty tons of coal and seven tons of coke. The arch was illuminated by 600 incandescents of 16 cp, which gave sufficient light to show up the detail at a distance of four city blocks.

The town during the celebration used about 300 kw of electrical energy for special illumination of this character. The current was supplied by the West Penn Electric Company, of Connellsville, which furnishes light and power over a district more than 100 miles in length, and of varying width, extending from Irwin on the main line of the Pennsylvania Railroad to Monongahela City on the river of that name. The output of the system is largely used for power in the various mines, over twenty of these having been connected up in the last year. The total of the power installations in mines alone is over 4,000 hp. The other large consumers for power purposes are mostly engaged in the various iron manufacturing businesses ranging from 100 to 500 hp. The company is rather proud of its success in this direction, in view of the fact that coal at the mines is worth from 65 to 75 cents per ton; while natural gas for power is obtainable at as low as 6 cents per 1,000 cu. ft.

The transmission circuit is run at 22,000 volts. That the lighting is not neglected is shown by the fact that the company has not yet succeeded in getting its load factor above 55 per cent, although this has been increased by 10 per cent in the past year. While the revenue has increased 30 per cent, the operating expenses have decreased about 5 per cent. We are indebted to Mr. Edwin T. Penrose, superintendent of the West Penn Company, Connellsville, for the above facts.

Doing Business in Brazil.

Mr. W. J. Johnston, known so well to all our readers, and now the editor and publisher of the *American Exporter*, who has been traveling with Secretary Root in South America, has made an interesting report to his journal on trade conditions in Brazil, and the opportunities for business there. At his request a copy has been furnished us. In the course of the report he says:

There is undoubtedly a large market in Brazil for manufactured articles from the United States—machinery, hardware, novelties, agricultural implements, automobiles and other vehicles, typewriters, shoes, textiles, drugs and proprietary medicines, food preparations and beverages, perfumes, paints, oils and varnishes, furniture, roofing, clocks and watches, steam and electrical specialties and the like. Manufacturers of such articles are probably more interested in some practical suggestions as to how they can market their products in Brazil than in an essay treating of the general commercial situation.

To begin with, the fact should be borne in mind that the conditions all favor a large trade between the United States and Brazil. The United States is Brazil's best market, taking more than half of her entire exports. We admit free of duty her coffee (to the extent in 1905 of $64,136,008), her India rubber ($28,476,252), her cacao ($1,238,859), her hides and skins ($2,364,207 free, besides $507,936 dutiable), her manganese ore and oxide of manganese ($990,044), making with other articles a total of 1905 free of duty of $97,966,274. It will thus readily be seen how seriously the prosperity of Brazil would be affected were we, for example, to impose even a small tax on her coffee.

The important special concessions recently made by Brazil in favor of certain lines of American goods and the answer which Brazil has made to other countries, which objected to the preferential arrangement with us, and which claimed equal privileges (under the favored nations' clause in their treaties) demonstrated that the statesmen of Brazil appreciate the situation. They frankly point out to these other countries that the commercial relations existing between the United States and Brazil are unique and that this is the reason why the special advantage is given to the United States.

It is considered not unlikely that rebates will be made from time to time on other lines of American manufactures; in fact American exporters may be able to secure additional concessions if they will only present the matter forcefully before the State Department. Secretary Root takes more than the ordinary patriotic interest in the extension of American foreign trade. He is now personally known to and highly esteemed by Brazilian officials. Never before have the Brazilians received a foreigner with such marked attention. A request later from the State Department is likely to receive careful consideration. If American manufacturers do not get further tariff advantages in Brazil the fault will be entirely their own.

The merchants of Brazil complain that while their customers demand and they are anxious to handle American goods, they are handicapped by the fact that the manufacturers of the United States insist on spot cash payments while they themselves can only sell their goods by giving their customers extended credit. True, they get liberal interest—usually twelve per cent, but as German and British manufacturers make no objection to giving credit, American manufacturers certainly lose many orders by not following the practice of other nations in this respect. Even where a Brazilian is able to pay cash, he resents as a personal slight insistence upon prompt payments. The Brazilian prides himself upon keeping his financial obligations and comparatively little is lost in bad debts.

Manufacturers of the United States who are in a position to grant credits and who wish to do something approaching the maximum business open to them in South America may find on investigation that the risk involved is less than they have imagined. In nine cases out of ten when I ask a merchant what American manufacturers should do to increase their volume of trade in Brazil the matter of credits is what he mentions first.

Dealers complain, too, that while the first letter they receive from an American manufacurer usually gives promise of opening up satisfactory business relations, the second one, in answer to their inquiry for prices and terms is so full of restrictions and an apparent lack of confidence in their commercial honesty that hope of inaugurating a business connection vanishes.

Germans are doing much of the business in Brazil that was formerly carried on by British manufacturers. This is due, primarily, to the fact that the German salesman is particularly well equipped in business training, languages and adaptability to secure the confidence of the Brazilians, and secondly, to the fact that German houses will modify their goods to meet the special Brazilian requirements. At the same time German goods are not well thought of in Brazil, and where the proper effort is made American goods will always sell in preference to German goods even at a considerably higher price. For example, nine-tenths of all the electrical machinery in Brazil is American.

CURRENT NEWS AND NOTES.

ELECTRICAL JOBBERS' CONVENTION.—A meeting is being held at Niagara Falls this week of American electrical jobbers, which promises to be very largely attended. Although the proceedings are not intended to be made public, it is understood that many important questions as to prices, discounts, trade relationships, etc., will be taken up. By Wednesday about 250 delegates and others were present. A meeting was held on Tuesday and another on Wednesday, with a reception and smoker on Tuesday evening, and a banquet on Thursday night. Meantime the usual Niagara entertainments will be enjoyed, and our telegraphic advices report social activity such as is always associated with a large electrical gathering.

COLORADO CONVENTION.—The Colorado Electric Light, Power and Railway Association will hold its convention at Denver on September 18, 19 and 20, when a large gathering is expected from all over the State. The programme includes a number of excellent items as follows: "Voltage regulation," by Mr. Leonard Wilson; "The Use of Polyphase Motors in Outlying Districts," by Mr. W. A. Carter; "Profitable Commercial Co-operation," by Mr. J. Robert Crouse, Jr.; "The Lighting of Small Stores," by Mr. J. R. Cravath; "Water Type Lightning Arresters," by Mr. A. M. Ballou; "Transformer Testing and Line Records for Transformers," by Mr. E. P. Dillon; "Steam Turbines," by Mr. C. C. Chappelle. The secretary of the association is Mr. George B. Tripp.

TELEPHONY IN CANADA.—It is stated by those engaged in the development that there are 73 absolutely independent or non-Bell companies and systems in Canada, with 3,248 shareholders and 12,073 subscribers. The capital invested is $850,000. Apparently these figures do not include all of New Brunswick or Nova Scotia. The Bell system in the Dominion had 78,195 subscribers at the beginning of the year, a gain of 12,035 over 1904.

JAPANESE STRIKE AMERICAN STYLE.—According to dispatches from Tokio, Japan, the employes of the street railway companies, who are on a strike, have adopted modern American methods to gain their point. The differences between the companies and their men culminated on the night of September 5 in riots in several districts of the city. Fifty-two cars were damaged and forty-seven motormen and conductors and eleven policemen were injured. Ninety-one arrests were made.

WIRES IN BALTIMORE.—Mayor Timanus, of Baltimore, Md., is having expert examination made to determine if the city cannot prevent the stringing of high and low-tension wires on the same poles throughout the city. The electrical workers' union has made complaint about the danger resulting, and it appears that it will be necessary to place the wires in municipal subways, this being the opinion of the city building inspector. The mayor, however, says that he thinks there may be some other way out, and will investigate further.

PREPOSTEROUS PUBLIC OWNERSHIP.—The Louisville *Courier-Journal,* discussing the Bryan plan of State railway ownership, says: "Public ownership of the railways involves not only a revolution, but a preposterous revolution. It means centralization, federalism, officialism, carried to lengths undreamed of by Frederick, by Napoleon and by Hamilton. It would work a change as sweeping as the abolition of property in land or the election of the President for life. Have we not the last ten years made breaks enough?"

PATENT OFFICE DELAYS.—It is alleged that although making a handsome surplus the United States Patent Office is far behind in its work, because of the inadequate staff. In January last there were 17,353 cases awaiting action. The number has been steadily growing, and a week ago reached 23,523. In January the average time for getting a patent through was three months. The time now is eleven months. At the present ratio of falling behind, unless an increase be made in the staff of the Patent Office, it will require years to get a patent issued.

A SWISS MONORAIL.—Switzerland now has a large number of electric third rail, rack rail or trolley systems for mountain travel. An entirely novel form of mountain railway is in course of construction up the Wetterhorn, starting from the foot of the upper glacier at Grindelwald. This is an electrically-worked elevated monorail, from which the car bodies are suspended by means of running gear. The cable is stationary, the tractive effort being exerted by motors on the moving vehicles. The alignment approximates the perpendicular. When completed this extraordinary railway will convey tourists through mid-air up to the Gleckstein Club huts, situated 7,695 ft. above sea level.

EXTENSION ENGINEERING COURSES.—The admirable work organized by Dr. S. Sheldon in the College of Arts and Engineering at the Polytechnic Institute of Brooklyn will be continued in 1906-7, and announcement is made of its engineering courses for extension students, designed specially to afford men in active practice opportunities for professional study. These courses embrace engineering, chemistry, physics, mathematics, drawing and languages and are conducted by means of lectures, discussions, reports, examinations, etc. Such well-known men as Messrs. Mailloux, Perrine, Mershon and Ashe are among the officers of instruction, each in a chosen field of study.

MARCHING THROUGH GEORGIA.—The new electric line across the State of Georgia, 170 miles east and west, is attracting considerable attention on account of the magnitude of the undertaking. The concern is chartered as the Atlanta & Carolina Railway, and it was first thought it merely proposed a line from Georgia City to Anderson, S. C., an important center. But the plans are much greater, and it is proposed to go through five counties on the east and six to the west. M. T. Edgerton, M. Mason, of Fulton County, and half a dozen more are on the list of incorporators, and it is said the enterprise is started in all good faith and will be pushed vigorously to completion.

POWER SCHEME FOR AUSTRALIA.—A gigantic electric power scheme, proposed by Messrs. J. M. and H. E. Coane, civil engineers, of Melbourne, and E. Kilburn Scott, professor of electrical engineering in the Sydney University, has been for some time under the consideration of the Victoria Government. It is projected, says the *British Australasian,* to build a reservoir, computed to be the largest in the world, at Trawool, by constructing a wall 175 ft. high, connecting two hills in close proximity, between which, in a defile, the Goulburn River flows. If this is done the engineers estimate that 750,000,000,000 cu. ft. of water may be banked up, of which 60,000,000,000 cu. ft. will be above the lowest level at which the fluid may be used for generating electricity.

SUDDEN INCREASE OF LOAD.—The New York Edison *Bulletin* for September notes the subjoined interesting incident: "The violent storm of Monday afternoon, July 9, will not soon be forgotten. In parts of the city it seemed as though the heavens were falling, and on some streets the water ran above the curb. All over Manhattan Island was the darkness of blackest night. The transformation from the bright hot sunlight of a July afternoon to the blackness of a starless night came suddenly, within the period of a few minutes. Before the storm arose the principal Edison station was supplying approximately 30,000 kw in electric power. The demand soon reached 75,000 kw. Yet there was not a perceptible variation in the candle-power of the lamps, nor at any time was there the slightest apprehension concerning the continued and unlimited supply of electric power."

BOOKKEEPING BY TELEPHONE.—Recent comments on the use of private telephones by municipal officers in Greater New York has brought out the fact that although critically ill and unable to leave his bed for days at a time, William Chambers, of Brooklyn, general bookkeeper of the Brooklyn borough administration, has for three months carried on a large part of his duties and looked after the borough's finances by use of a telephone. When he was too weak to be driven to his office Public Works Commissioner Dunne asked permission to put a telephone in Mr. Chambers' house, so the latter could be consulted on important matters. His physician objected, but Mr. Chambers consented, and for the last three months heads of departments and bookkeepers have called him by telephone several times a day for instructions and information. He carried all the important business in his head.

NATURE AND ORIGIN OF VOLCANIC HEAT.—In a recent issue of *Science,* Prof. Elihu Thomson sets forth an interesting hypothesis on the nature and origin of volcanic heat. The hypothesis of a molten or more or less fluid interior of the earth is rejected, as is also the recent speculation that volcanic activity is due to the presence of radium. Prof. Thomson considers it probable that the earth's interior is metallic iron, surmounted by a covering of oxidized lighter material slag-like in character, but altered by water and sedimentation. The cause of volcanic heat and eruption is ascribed to the movement under great pressure of rock masses, caused by flexures in the earth's crust. Such flexures taking place in the crust of the earth or in the outer portions of its mass may bring sufficient pressure to bear on deep-seated solid rock masses to cause them to readjust their positions. This would mean the movement of the rock masses over considerable distances at high pressure, thereby developing great heat and resulting finally in molten streams ready to escape upward from the pressure exerted on them. From this hypothesis explanations are deduced for the various kinds of volcanic phenomena.

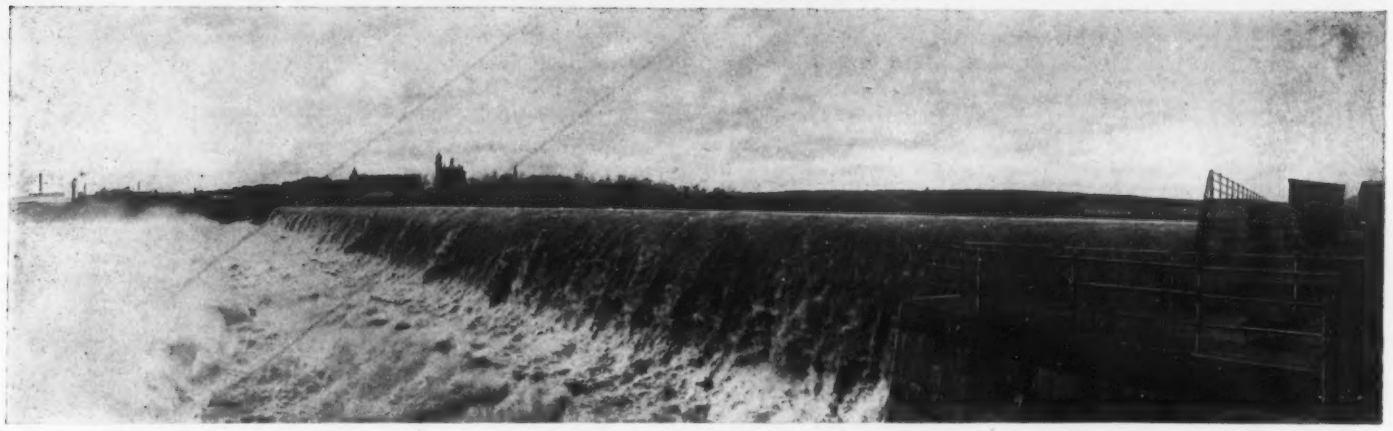
WIRELESS AT MT. GRETNA.—The military instruction camp for the Department of the East at Mt. Gretna, Pa., has proved a success, and has witnessed much work of interest. For the first time wireless telegraphy was successfully used by the signal corps. Messages were sent and received at distances of from five to 100 miles. This success was largely due to a new receiver invented by Major Russell of the Signal Corps at Washington. The main station was at the camp proper, where the "harp" was stretched between two giant chestnut trees. The other station was portable, and was operated in the field wherever the troops were engaged in a sham battle. To elevate wire which catches the sound wave a kite was used. Wherever the kite was sent up the portable instrument was put in operation and communication readily established between the troops in the field and the camp headquarters, five or six miles away. These messages were also sent as far as Philadelphia, about 100 miles.

THIRTY YEARS OF TELEPHONE.—An interesting article appears on the invention and use of the telephone, in *Scribner's Magazine* for September. By coincidence an interview with Prof. Bell, by the well-known correspondent, Mr. F. G. Carpenter, appears in the Pittsburg *Dispatch* and other papers, in the course of which the great inventor says: "Prof. Gray made his claims, I believe, at the instance of his lawyers, and largely through the influence of the directors of a great telegraph company, who then feared that the telephone might injure the telegraph. He had, however, fortunately for me, written me a letter of congratulation upon learning that I had made my discovery and disclaiming it for himself; and this letter was brought forth as evidence with the other testimony before the courts. Prof. Gray and myself were working at multiplex telegraphy at about the same time; and his discoveries were so much like mine that I was for a time afraid of him and thought he had some way of getting at the secrets of my laboratory work. It was for that reason that I changed my laboratory. When I afterwards met Prof. Gray I realized that his character was such that he could not have done anything of the kind I had imagined and I regretted my unjust suspicions." This tribute to the memory of Dr. Gray is generous and well-deserved, but it is an open secret that Gray died in the belief that he at least invented the telephone about the same time that Bell did.

SAFETY STATIONS IN MINES.—Mr. J. L. Dixon, in a recent article in *Mines and Minerals*, suggests that in every dangerous mine safety stations should be placed. They should be excavated in the solid coal and the approach should be by a long, narrow entrance which could easily be rendered explosion-proof. The chambers should be about 15 ft. by 30 ft. and should be connected with the surface by a compressed air line, which should be put down a bore hole directly into the chamber, or should be laid in the mine in such a way that no explosion would disturb it. This should be done by laying it in a ditch made for that purpose, or by covering it in such a manner that the line would not be broken by falls of rock. Connections should be made from this pipe into each chamber of refuge, which, when turned on, would give a sufficient supply of air to any refugees who may be so fortunate as to reach them. These chambers should be amply provided with first aids to the injured, with restoratives, with condensed foods, all in damp-proof cases. They should also be supplied with electric safety lamps, flasks of oxygen and with modern life-saving appliances so that the safety chamber could be used as a base from which rescuers could go forth to the aid of those unable to reach the station. These places should also be connected with the surface by an explosion-proof telephone system. This can be done by laying the wire in the compressed air pipe. Mr. Dixon asserts that there is not one explosion-proof telephone system in any mine in the United States.

THE WIRELESS CONFERENCE.—Discussing the recent proposals of this journal that governments at the coming conference should select special frequencies for their own work, so as to leave commercial business free from disturbance, the New York *Times* says: "It is to be expected, or at least hoped, that the International Conference on Wireless Telegraphy to take place in Berlin next month, with representatives from the various national governments, will attempt to delimit the scope of government interference with individual enterprise in the development of this applied science, now in its infancy. The Russo-Japanese war demonstrated that wireless communications could not only be intercepted by the enemy, but also obstructed by the transmission of meaningless messages or even false information. So long as this shall be possible it is right that a government should retain control of all extra-territorial wireless telegraphy in time of war. But the Electrical World urges the perfectly reasonable view that a government ought not therefore to hamper enterprise by unduly restricting the application of wireless telegraphy in time of peace. It is now possible to so "tune" wireless equipments that signals may be shut out which lie a small percentage above the wave length to which the tuning corresponds. It is, of course, requisite that governments insist upon all wirelessly equipped vessels, no matter of what flag, or what wireless system they may employ, receiving messages on the score of public safety, as from vessels in distress. But it will be strongly urged at the Berlin conference that seacoast wireless stations be tuned to, say, one or two definite frequencies, that they may not conflict with equipments afloat or ashore tuned to other frequencies; and that mercantile marine vessels and naval vessels be confined to particular wave lengths respectively. This would enable any wireless telegraph enterprise to be carried on in time of peace without friction with naval or mercantile communication, by the simple expedient of keeping outside of the wave lengths prescribed for such communication. If this practical recommendation shall be adopted, private enterprise, private experiments and technical research may proceed unrestricted with benefit to an art now threatened by governmental 'regulation' almost amounting to confiscation."

BULLETIN OF BUREAU OF STANDARDS.—The first number of Vol. 2 of the *Bulletin* of the U. S. Bureau of Standards is confined entirely to electrical subjects, and it is no exaggeration to say that the five papers appearing in this number are not equalled in intrinsic value by the contents of any single issue from the American scientific periodical press for many years, if ever. Mechanically, this number is also interesting from the fact that the paper on which it is printed was made according to specifications prepared with a view to obtaining a paper of a kind that will not easily deteriorate with age. The rapid deterioration of modern printing papers is becoming a matter of serious concern, particularly in connection with scientific publications, and the Bureau of Standards by its recognition of this condition, and taking the lead toward its betterment, is rendering a valuable public service. It is to be hoped that the Bureau may find it within its province to add to its functions the analysis of printing papers, as this would go far in causing a return to the use of printing paper of lasting quality. The first paper in the "Bulletin" is by Mr. Edward P. Hyde, and gives the result of an elaborate investigation of the Talbot law upon which the principle of the rotating sectored disc rests. The investigation thoroughly confirmed the accuracy of this valuable adjunct in photometric investigation, by means of which light sources of widely different candle power may be accurately compared. Dr. Carl E. Guthe in a paper gives in full detail the method used in a new determination by absolute electrometer of the e.m.f. of the Weston and Clark standard cells, and Dr. E. B. Rosa in the following paper gives the theory of the absolute electrometer used in this investigation. Mr. J. G. Coffin contributes an admirably written paper on the "Construction and Calculation of Absolute Standards of Inductions," describing in minute detail the construction of a standard of inductance, and including an exhaustive discussion of the theory of the calculation of inductance. The inductance standard made for the Bureau by Mr. Coffin is wound in three sections on a hollow marble cylinder about 20 ins. in diameter and 20 ins. long. The total inductance is .18 henry and the total resistance 62.71 ohms. The final paper is by Drs. Edward P. Hyde and H. P. Brooks on "An Efficiency Meter for Electric Incandescent Lamps." The authors contributed an article on the same subject to these columns in the issue of December 2, 1905.



DAM ACROSS THE CONNECTICUT RIVER AT HOLYOKE, MASS.

Electric Generating Station of the Holyoke Water Power Company.

THE water power at Holyoke, Mass., is the largest in New England and one of the largest developed in the United States. The Paper City is situated on the right bank of the Connecticut, just below the great rift in the mountain range where the river winds between Mt. Holyoke and Mt. Tom. In the summer of 1847 the volume of water flowing in the river at low water mark was carefully gauged and found to be 6,000 cu. ft. per second,—the equivalent of 30,000 horse-power. The following year a wooden dam was built across the river by the predecessor of the present company which was organized for the purpose of constructing and maintaining a dam across the Connecticut River and one or more locks and canals, and of creating a water-power to be used for manufacturing purposes. Eleven hundred acres of land were purchased, and while the canals and mills, streets and dwellings were pushed forward to satisfactory completion, the dam which had been meanwhile constructed toppled over and gave way before the water reached the crest. Another dam was built in 1849, which at the time of its completion was the largest in the world; this dam is still standing, although a magnificent masonry dam has since been built to replace it.

The system of canals at Holyoke is commensurate with the volume of water to be distributed. Thirteen gates each 15 ft. long by 8 ft. wide admit the water to the upper level canal. This main artery of the canal system starting with a width of 140 ft. and a water depth of 22 ft., extends eastward past the waste-weir about 1,000 ft. and then sweeps southward in a straight line for a distance of more than a mile, to supply the upper tier of mills, the width gradually lessening at the rate of one foot in every hundred. The second level canal begins opposite the terminus of the reach of the upper level and runs in a northerly direction for a mile or more parallel to the upper level canal and 400 ft. east of it. This portion serves as a raceway for the upper level and also as a canal for the supply of the mills below. The second level canal then flows east and south for a mile and a quarter more at a distance of about 400 ft. from the river; this marginal portion of the second level

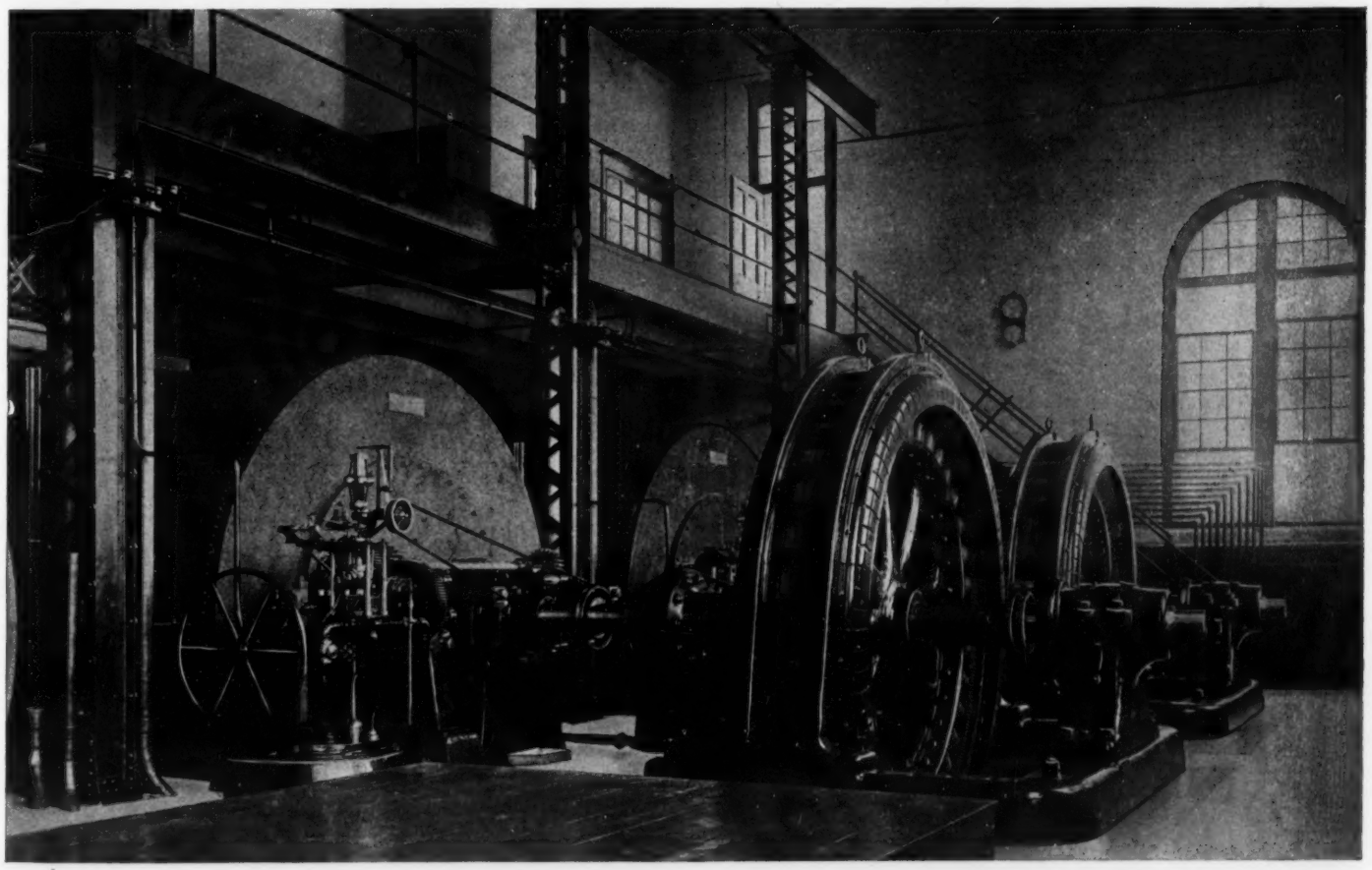


FIG. 1.—INTERIOR VIEW OF THE HOLYOKE WATER POWER COMPANY'S STATION.

affording mill sites along its entire length, from which the water passes directly into the river. For 2,000 ft. this canal has a width of 140 ft. and thence the sides gradually converge to a width of 100 ft. which is continued to either end, the average depth of water being 15 ft. The third level canal, 100 ft. wide and 10 ft. deep, is also a marginal canal with mill sites along its entire length. It begins at the southerly end of the second level, extends 3,550 ft. to the other terminus of the same canal, thus making with the latter, a line of marginal canals around and near the whole water front of the city. The mills on the upper level have a head and fall of water of 20 ft., the difference between the second and third levels is 12 ft., while the fall between the marginal canals and the river averages 28 ft. The total head from the crest to the tail water from the third level canal at the average height of the river is 60 ft. Thus most of the water is used three times.

Surveys for the new stone dam were begun in 1891, and the dam was finally completed about 10 years later. The total length of the rollway between abutments is 1,020 ft., the height, 30 ft., the base, 54 ft., and the crest, 7 ft. The upper part of the curve of the downstream face of the dam is a parabola, the parabola selected being the theoretical form assumed by a body of water flowing freely 4 ft. in depth over the crest of the dam. The parabola extends down the slope as far as the point of reversal and below this curve is a cycloid, selected as the curve of quickest descent. The face of the dam is of granite, the top being polished. The upcurve at the extreme toe is designed to break the force of the water and to prevent its cutting into the ledge beyond. The slope of the upstream face is equivalent to a batter of one foot in five. It is stepped off every five feet in height in order to afford a footing for the coffers. The dam is considered to be one of the finest pieces of masonry work in the country. Each stone is laid to line, grade and batter. The stones were leveled and lined by instruments and the batter was obtained from templates. The joints in the face of the stone are only ¼-in. wide. The drainage area of the Connecticut above the dam is estimated at 8,000 square miles and measurements taken of the daily average flow of the river showed that this was in the neighborhood of 11,951 cu. ft. per second, equivalent to 82,000 theoretical horse-power.

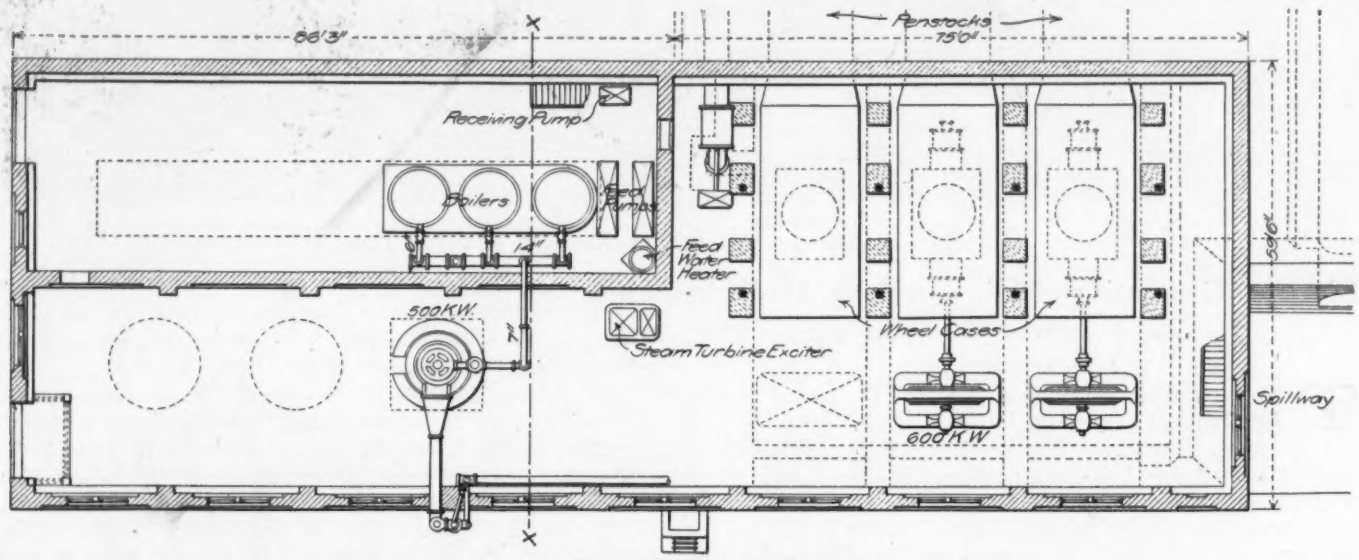


Fig. 2.—Plan View of the Station.

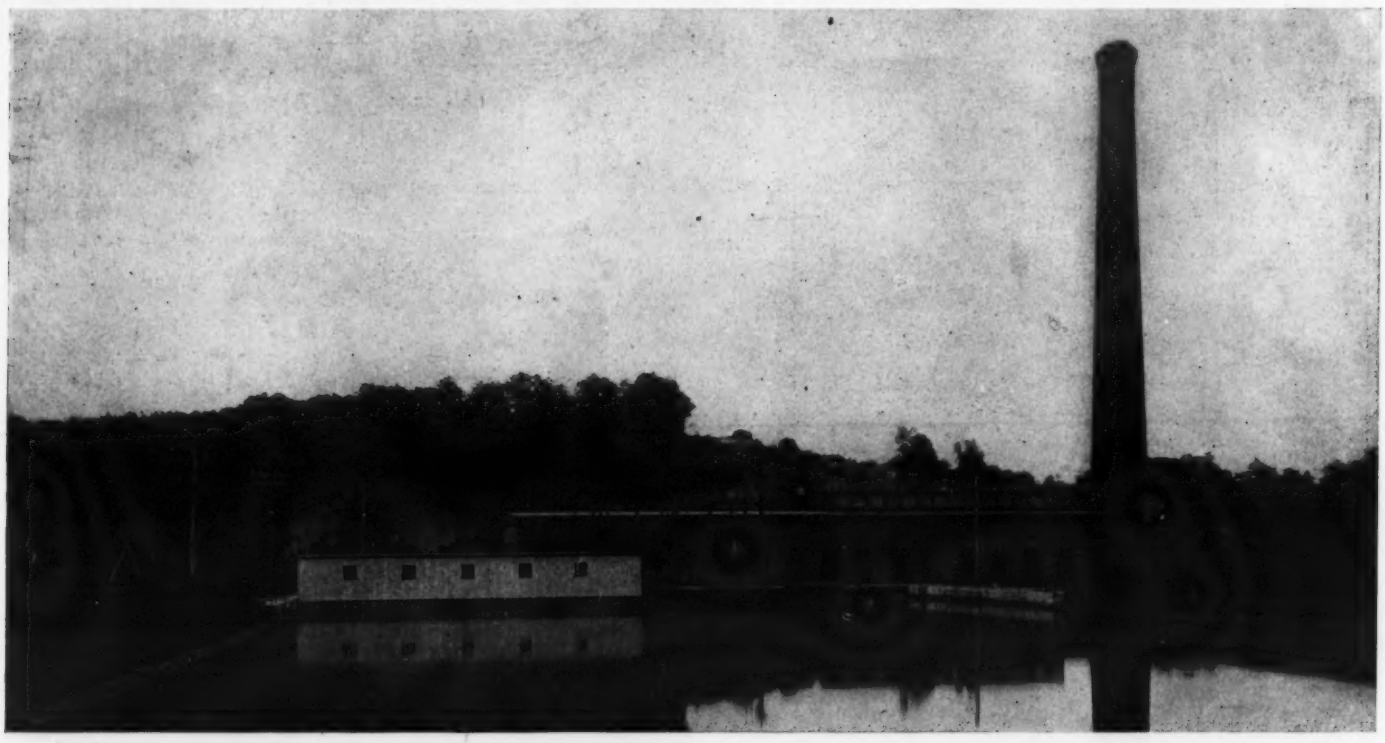


Fig. 3.—West Side of the Station, Showing Head Gates and Spillway.

The Holyoke Water Power Company realized a few years ago that the sites along the canals where mills could be supplied with water power were fast being used up and that new industries situated on the hills back of the canals would have to depend on some other motive power. It was also found necessary as a precautionary measure to install another spillway, or overflow, from the second level canal to the river in addition to the three already provided; since if the mills on the second level canal were to shut down for any reason and the mills on the first level canal were to continue in operation, the water in the second level canal would overflow its banks because of the inadequacy of the existing overflows. Moreover, surplus capacity valued at about $100,000 per year was being continually wasted. The company therefore decided to erect a power station at the most convenient point hydraulically, where the surplus capacity of the river could be used to furnish power to available sites on the opposite side of the canal and on the river front, because it would be very expensive to build water connections from the canals to the mills on the latter site.

With this idea in mind the company applied to the legislature for a charter empowering it to manufacture electricity for power purposes within the city of Holyoke and the town of South Hadley and to sell and distribute it in any of the cities and towns within the counties of Hampden and Hampshire upon receiving the approval of the mayor and aldermen of any such city or of the selectmen of the town; provided, however, that electricity should not be sold or delivered to any one purchaser in a quantity less than 100 horse-power at any time, nor until the company had made with the purchaser a contract providing that such purchaser should use the electricity in his own business only and upon his own property. The charter, which was granted in May, 1903, also provided that the company could sell electricity to any city or town within the counties mentioned, which had established or might establish a municipal lighting plant. After this act was passed there were many other details to be attended to, such as permission from the harbor and land commissioners

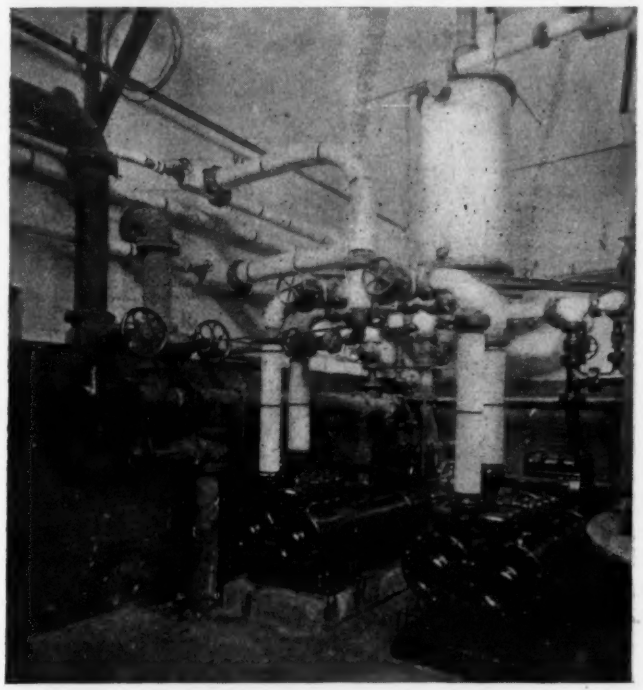


FIG. 4.—FEED PUMPS AND HEATER.

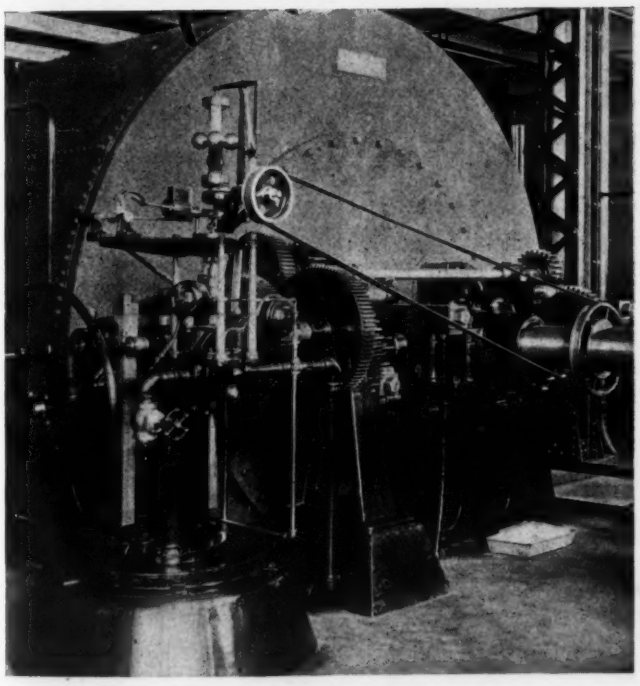


FIG. 5.—GOVERNOR AND WATER-WHEEL GATE RIGGING.

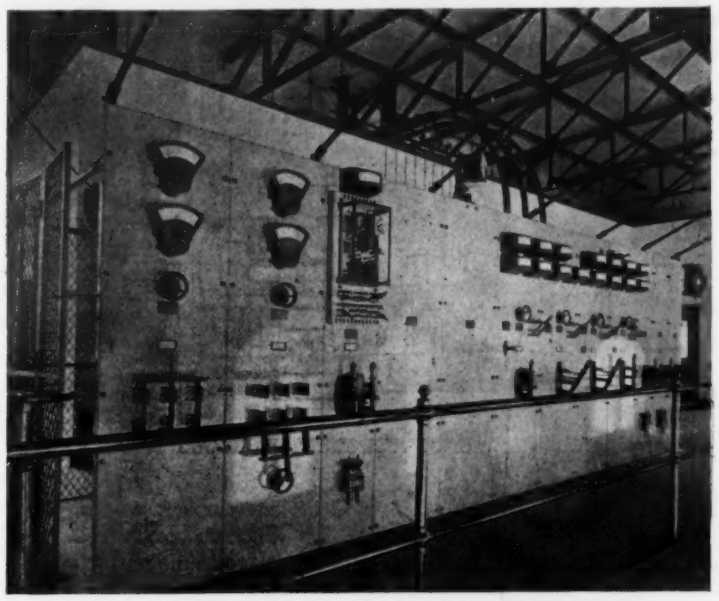


FIG. 6.—VIEW OF THE SWITCHBOARD.

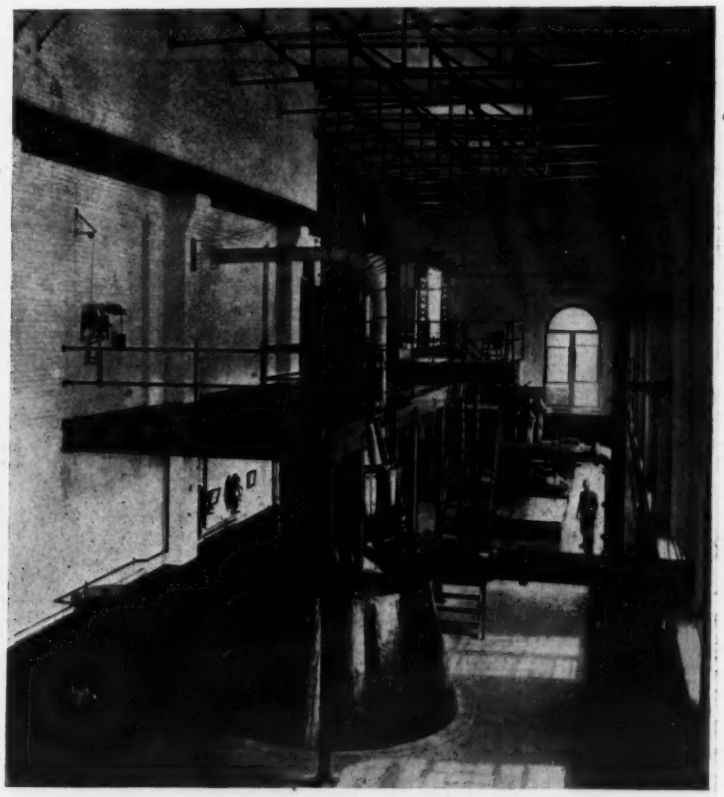


FIG. 7.—GENERAL VIEW OF STATION INTERIOR.

to erect the plant on the river bank, permission from the board of aldermen to erect poles and string wires in the city, etc. All of this took time, and it was only a little over a year ago that ground was broken for the new station. According to the act passed by the legislature, the new plant had to be ready for business three years after the passage of the act, and this requirement was complied with to the letter as the new plant was ready for operation at the time specified.

used about 30 per cent of the time; the station being under full load.

The station is located at the foot of East Dwight Street on the west bank of the river. The building is a brick and steel structure, two stories high, 161 ft. long and 60 ft. wide. For light, cleanliness and comfort there are few stations in the country equal to it and certainly none better. The side walls and ceilings are tinted dead white, all the iron work is painted black and the

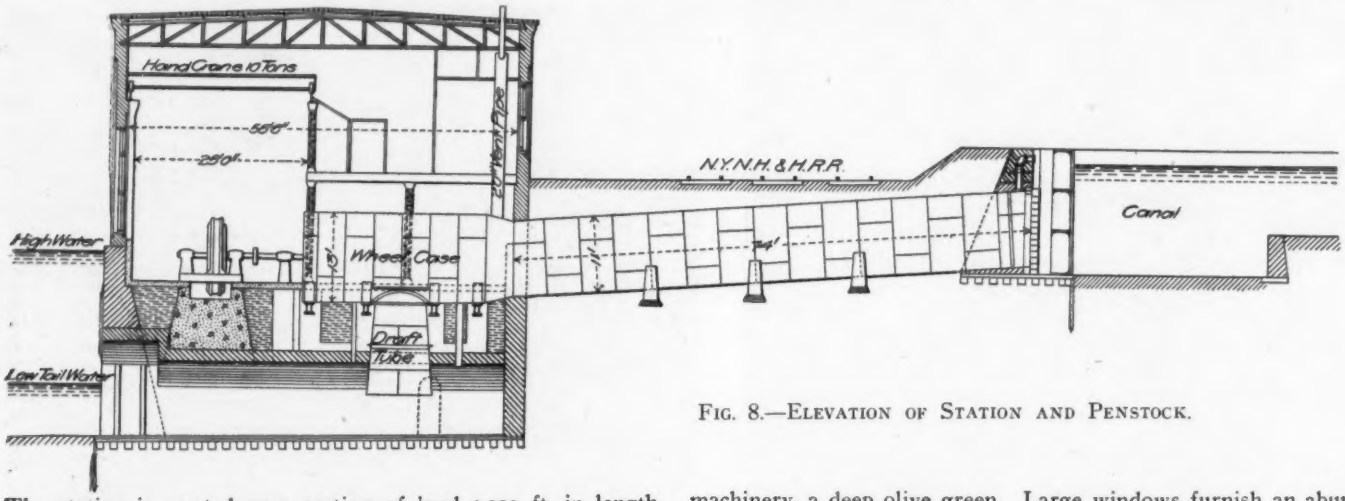


FIG. 8.—ELEVATION OF STATION AND PENSTOCK.

The station is erected on a section of land 2,000 ft. in length representing the most valuable mill sites which the company has left. There is a large portion of this tract remaining which is available for mill sites and power for which can now be furnished from the new electrical plant instead of from the canals. To use water on any of these sites would necessitate large expenditures in putting in tail races alone, since these would have to run under two railroads and a street to connect with the intake. The station is connected with the municipal lighting station so that in case of accident the street lighting can be supplied from the former station. Electricity may be generated by means of steam or water or both. Steam turbines and boilers have been installed for use when the water is low and also to help out should the load assume such proportions that the water available is insufficient to carry it. From gaugings of the river for the past 20 years experience has shown that in wet years steam will only be required 2 per cent of the time, while in years when the rainfall is much below normal, the steam plant will be

FIG. 9.—BY-PASSING AND WATER INTAKES TO BOILERS.

machinery, a deep olive green. Large windows furnish an abundance of natural light by day and at night the interior is illuminated by clusters of incandescent lamps. The floors are of a deep red cement compound bordered with black. This is as soft as wood and as noiseless as rubber. The flooring is in all cases extended up in a curve around the sides of the rooms to form

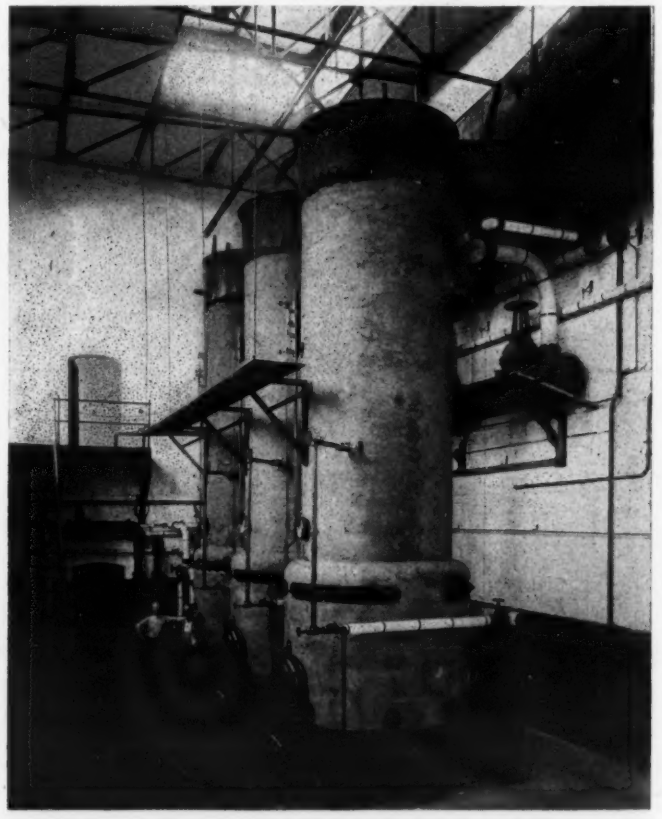


FIG. 10.—GENERAL VIEW OF BOILER ROOM.

a base board, thus avoiding angles or cracks at the junctions of the floor and the baseboard which serve as dust and dirt traps. Every convenience for the comfort of the employees has been installed, such as lockers, toilet rooms, wash rooms, shower baths, etc., and the connection and feeling between the employer and employee are close and very friendly, so much so that it is worthy of comment.

The hydro-electric equipment at present installed consists of two twin water wheels each having a capacity of 1,000 horsepower. These wheels are direct-connected to 600-kw, 2,300-

volt, three-phase alternators. There is space left for a third pair of water-wheels of the same capacity as the others, the wheel case, penstock, etc., for this being already in place. There is also a small water-wheel direct-connected to a 50-kw, 125-volt, direct-current exciter.

Midway between Mosher and Appleton Streets is located the extension of the second level canal which becomes a feeder to the electrical plant. The head and fall at the ordinary river level at this point is 32 ft. The inlet from the second level canal to the extension is provided by five arches and one ice way. The arches and ice way carry three tracks of the Boston & Maine Railroad and also Water Street. The canal extension is 120 ft. wide at the line of full canal and 80 ft. at the bottom with a depth of water of 10 ft. The canal terminates just west of three freight tracks of the New York, New Haven & Hartford Railroad. Four penstocks running from the head gates at the terminus of the canal supply the water to the power plant. Three of these penstocks are 11 ft. in diameter and supply the three water wheels driving the alternators, while the fourth penstock is 3 ft. in diameter and supplies the wheel driving the exciter. The penstocks are 75 ft. long and pass under the New York, New Haven & Hartford Railroad tracks connecting directly with the water-wheel cases, which are 13 ft. in diameter and 34 ft. long. In each wheel case are located two 39-in. McCormick wheels discharging by draft tubes into raceways and thence to the river. At the terminus of the canal, in addition to the headgates, is located an overflow to control the height of the water in the second level canal. This overflow is of granite masonry with a spillway 75 ft. long and is provided with four 4½ x 4½-ft. wicket gates and removable flashboards 3 ft. in depth. The capacity of the spillway is 60 mill powers, a mill power at Holyoke being considered equivalent to 65 horse-power. The grillage under the arches in the intake is of 12x12 hemlock on gravel, covered by 6-in. hemlock splined; the side walls are of concrete and the arches are of brick. Where the railroad tracks cross the penstocks concrete piers two feet thick are provided to relieve the penstocks of pressure from passing trains. A 16-in. cast-iron main is also laid from the canal to the power house and supplies water for boiler feed and also for condensing purposes. Each penstock is provided with an 8-in. cast-iron vent pipe to break any vacuum which might form in the penstock owing to the sudden closing of the gates. No trouble is anticipated with ice in winter since this can be shunted out through the spillway into the river.

The steam auxiliary equipment of the plant occupies the westerly portion of the power house and comprises a turbine room which is a continuation of the wheel room, and a boiler room which is partitioned off from the remainder of the building by brick division walls. The crane runway for the 10-ton hand-operated traveling crane is carried through from the wheel room the full length of the turbine room so as to serve the entire machinery equipment. A feature of the plant is that the main floor is located 4 ft. below the level of the highest stage of water that has been recorded in the Connecticut River. Special precautions were accordingly taken to waterproof the entire floor and the side walls of the building up to a point 6 ft. above the finished floor level. Furthermore all window openings on the river side are located 7 ft. above the floor level so that the water would need to rise more than 3 ft. above its previous highest stage in order to enter the building.

The total capacity of the steam generating equipment that has been provided for is three 500-kw steam turbine units and seven 200-hp boilers, although owing to the present excess of water power available over the maximum possible demands of the power distribution service, only one turbine unit and three of the boilers have been installed and these only for the purpose of providing against any emergency which might arise from disabled wheel equipment or possible abnormal low water condition in the river. While it is expected that the steam plant will seldom be used, the steam plant is not in any sense a temporary installation, nor have any details been slighted. Owing to the very fact of the extended periods of idleness which this equipment will experience, every precaution has been taken to render all of the apparatus serviceable at any time, when suddenly called upon in emergency. The steam plant has been designed with unusual care and the best materials and arrangement of apparatus have been adopted which best insures against the equipment becoming unserviceable by disuse.

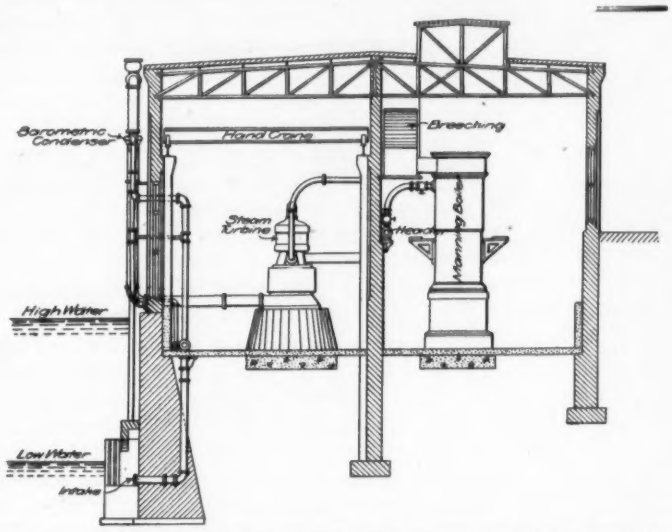


FIG. 11.—SECTION ELEVATION OF STEAM TURBINE AND BOILER ROOMS.

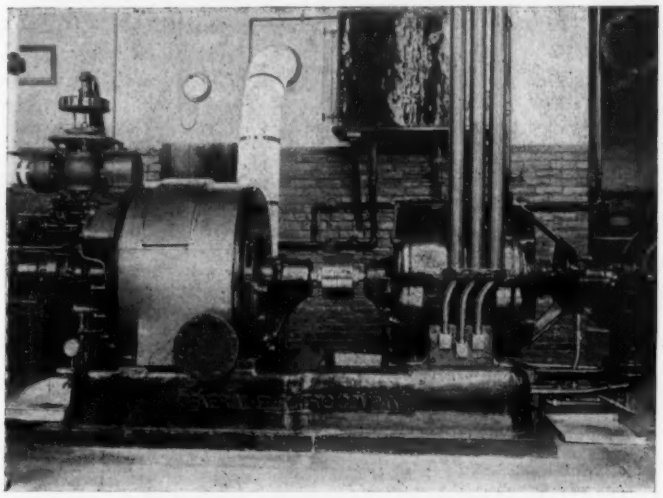


FIG. 15.—STEAM-TURBINE DRIVEN EXCITER UNIT.

FIG. 12.—OVERFLOW GATE HOUSE.

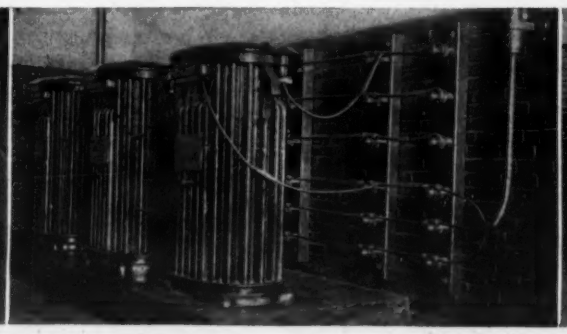


FIG. 13.—STEP-UP OIL-COOLED TRANSFORMERS.

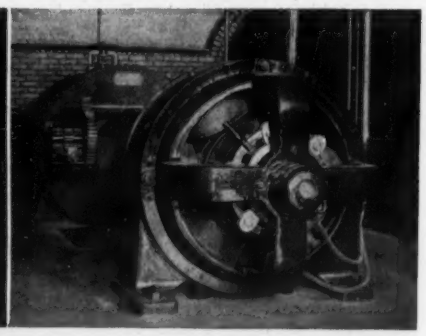


FIG. 14.—WATER-TURBINE DRIVEN EXCITER.

The boiler equipment consists of three Manning type vertical boilers, each of 200 hp capacity, which were built by the Holyoke Steam Boiler Works. Runways are provided along both front and rear of the boilers at a point 15 ft. above the floor level for access to gauges, fittings and pipe connections. A 175-ft. radial brick stack with 7-ft. flue is provided.

The coal supply for the plant is provided in a large open storage pit at the rear of the building between the stack and the roadway adjoining the railroad tracks on the boiler room side. The pit is built at the boiler room floor level and has heavy concrete retaining walls surrounding it which are built up to a height of the ground level at the rear. This permits of dumping coal direct to the storage pit from cars on the adjoining tracks. The capacity of the storage pit is 2,500 tons. Coal is handled from the pit to the boiler room by narrow-gauge charging cars which run on floor plate tracks laid in the floor construction, thus permitting the coal to be shoveled directly from the cars to the boiler furnaces. A good grade of bituminous coal is used costing $4 to $4.10 per ton delivered, for which plain end fired rocking grates are used in the furnaces.

The boiler feeding system is in duplicate throughout and there are four distinct sources of supply—the canal, river, city water mains and condenser hot well. There are two feed pumps installed, each one of which is capable of supplying the entire equipment. These pumps deliver through 3-in. connections to the feed-water heater, which is by-passed for direct delivery to the feed lines if desired. There are two feed lines of 3-in. extra heavy brass piping, one of which has branch connections to feed the boilers at points 5 ft. above the crown sheets while the other

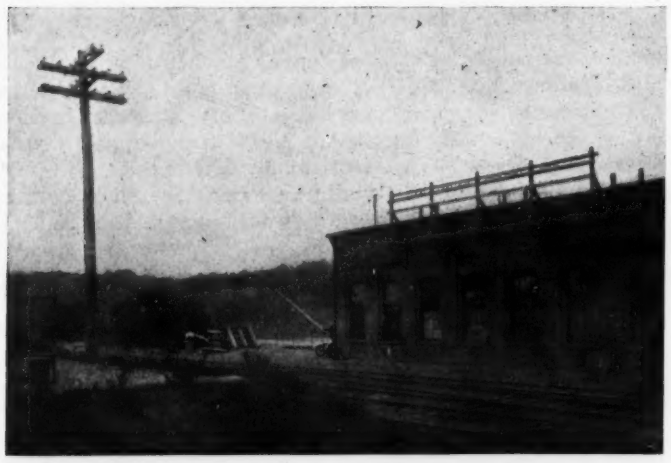


FIG. 16.—OUTGOING FEEDER AND TRANSMISSION LINE RACK.

has its delivery branches connected into the boiler blow-off connections at the rear of the mud ring.

The steam piping system is also installed in duplicate, there being a main header from which the turbines are to be supplied and an auxiliary header which supplies the exciter turbine, the pumps and auxiliaries, and which may also be utilized in supplying the turbine if a section of the main header be temporarily out of service. The main header is a 14-in. extra heavy steel pipe with 6-in. branches through long radius bends to the boiler steam nozzles, which branches are fitted with a gate valve at the header and a non-return stop valve at the boiler nozzle. The auxiliary main is of 5-in. pipe and is also supplied by 2-in. boiler branches which connect through gate valves to outlets from the boiler nozzles. The main header has at present only a single delivery connection, consisting of a 7-in. branch to the thottle of the steam turbine, which is carried through the wall through a 180-deg. long radius bend. The auxiliary main has a 3-in. branch supplying the steam turbine exciter unit, another 3-in. branch with connections to each of the boiler-feed pumps and further branches to the step-bearing pumps and oil pumps. The exhaust system has been rendered simple by the use of an independent condenser for the generating unit to which a short-distance connection is made from the turbine across to the outer wall of the turbine room. The steam auxiliaries exhaust direct to the feed water heater, the exciter unit through an 8-in. exhaust pipe and the pumps through a 4-in. connection, and from the top of the feed-water heater which is located in an elevated position in the rear corner of the boiler room, an atmospheric vent connection is made to an exhaust head above the roof. The high pressure steam lines are all dripped to a receiver pump which discharges into the hot well while the dirty drips from the auxiliary exhaust connections are pumped into the river.

The steam turbine generating unit is a 500-kw Curtis turbine supplied by the General Electric Co., with mechanical operated governing mechanism. The turbine operates at 900 r.p.m. and is designed for an overload capacity of 25 per cent continuously. It exhausts through a 16-in. pipe connection extending directly across through the outer wall of the power house where it is carried up to a Bulkley barometric condenser of 800 hp capacity. At the top of the exhaust riser connection there is an atmospheric relief valve, permitting free exhaust to the atmosphere in case of failure of the condenser equipment. The injection water for the condensers is taken ordinarily from the canal and drawn by vacuum into the jets, a lift of from 10 to 12 ft. The connections are also provided permitting of handling water from an intake from the river below and also for the use of city water in starting the condenser into operation. The discharge of the condenser is delivered through a 6-in. pipe to the hot well in the boiler room but also has a connection to the river.

The cables from the electric generators are run in iron pipe conduit embedded in the floor to the columns supporting the switchboard gallery. The conduit is continued up along these and under the floor of the gallery back of the switchboard where they connect with oil switches. The cable from the steam turbine is No. 000 paper insulated, while the cables from the water turbines are No. 0000 in duplicate. The field coil wires are No. 00. Two conduits are provided, one for the generator cables and the other for the field coil wires; the latter carrying in addition the electric wires supplying the small motor on the water wheel governors. From the oil switches the 2,300-volt current passes to the bus-bars, thence to the feeder panel switch and out. Three-wire No. 000 single-conductor, rubber-covered cable is run in 1-in. conduit from each feeder switch to the outside of the building. Lightning arresters are tapped back from each feeder, the arresters being situated on the wall of the store room back of the switchboard. At present there are three outgoing feeder lines, one of which is not in use. One line is connected with the municipal plant switchboard so as to furnish the city with any amount of electricity when called on to do so. Thursday and Saturday nights the stores in Holyoke remain open for shopping and on these nights the municipal lighting plant is unable to carry all the load. The arrangement also permits the municipal plant to shut down for repairs, the entire load then being carried by the Holyoke Water Power Co.'s plant. The other feeder runs along the highways to Perkins Paper Mill in South Hadley which is operated by induction motors. The length of this line is over four miles, and the voltage is stepped up to 6,600 volts by three oil-cooled transformers of 75-kw capacity each.

A view of the switchboard is shown in one of the engravings. This is made up of 12 panels—two exciter, one regulating, six generator, three of which are blank, and three feeder panels. The panels controlling the 600-kw generators are provided with push-button switches for controlling the water-wheel governors. The switches are connected to a three-wire system feeding a small motor attached to the governor mechanism. This motor serves to shorten or lengthen the valve stem according to the will of the operator. Heretofore in bringing alternators into synchronism it has been necessary for one man to watch the synchronizing lamps while an assistant stood by the governor and changed its speed according to signals received from the switchboard attendant. By means of the push button system of control the switchboard attendant is enabled to raise or lower the speed of the water-wheel and hence that of the alternator to be thrown in parallel without taking his eyes from the synchronizing lamps or synchronizer by merely placing his fingers on one or both of the push buttons. The current for operating the small motor is taken from the exciter circuit. A small worm is mounted on the armature shaft and this drives a worm gear on a vertical pinion shaft. This pinion transmits rotary motion to a gear, which being threaded through its hub, acts as a right and left coupling to draw together or push apart the two portions of the valve stem upon which it rotates. A Tirrill regulator of latest design is used to regulate the voltage.

Self-Exciting, Low-Frequency Alternator.

BY G. FACCIOLI.

IN developing the "image current" type of alternators, that is to say, alternators in which the reaction due to load currents is annulled by reproduced or "image" currents in the magnetizing circuits, as described in the issue of the ELECTRICAL WORLD for July 14, 1906, it was necessary to find a method of commercial generating currents of very low frequency to be used for the excitation of such alternators. In studying this problem, Mr. William Stanley undertook the construction of an alternator which would deliver polyphase currents of five cycles or lower frequency, at normal speed, and devised the self-exciting generator which is discussed below. This machine is highly interesting because of the novel and peculiar phenomena involved in its self-excitation and because the stator and rotor windings are both effective in producing the energizing field and in delivering load currents to the external circuits.

It is evident that if the field of an ordinary direct-current machine is slowly alternated, corresponding alternations in the e.m.f. of the armature will occur. Such a machine could be driven at any speed and would give alternating current through its commutator and brushes corresponding in frequency to the frequency of its field, but it could furnish single-phase currents only. It is evident, also, that two such machines could be coupled on the same shaft, each machine having its field excited by low frequency currents differing in time-phase, and this arrangement would generate from the two armatures, two e.m.f.s differing in phase, whose frequency is independent of the frequency of rotation. If now, these two fields are combined in one machine, that is, if the field is rotating instead of periodic, it is evident that one armature with a single commutator and four brushes placed in electrical space quadrature around it will deliver two sets of alternating e.m.f.s differing in phase by the angle of the brush displacement and at the same frequency as the rotating field, and that the frequency of the currents thus obtained will be independent of the frequency of rotation. Such an arrangement is shown in Fig. 1, and it presupposes the employment of a third element to furnish the current for exciting the field.

In order to make this generator self-exciting and self-contained, the scheme represented in Fig. 2 has been devised by Mr. Stanley. First, it is to be noted that the usual method of

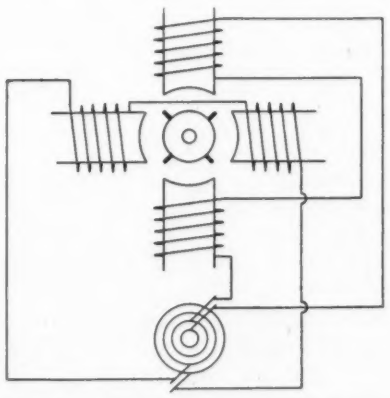


FIG. 1.—SEPARATELY EXCITED LOW-FREQUENCY ALTERNATOR.

self-exciting a machine of the continuous-current type is to connect the brushes collecting the currents from the armature to a field coil so located with reference to these brushes that the currents in the coil will increase the e.m.f. between the same brushes. This cumulative action between the armature and the field coils continues until limited by the saturation of the iron of the machine. In the machine here described, however, each pair of brushes is connected to a field coil so located with reference to these brushes that the flux it produces will be displaced by a pre-determined angle dependent upon the number of phases desired. Figure 2 illustrates the connection and operation of self-excitation by means of two-phase currents.

Let the residual magnetism of the machine be as shown by the arrows in Fig. 2, then on rotating the armature an e.m.f. will be developed between the brushes 2 and 4. These brushes are connected to the stator winding at X-X', instead of at Y-Y' as is usual in exciting continuous current machines. Consequently, a current will flow from X through a-a to X', producing a flux through the armature at 90° to the residual magnetism. A resultant field will, therefore, lie between the points Y-X and Y'-X', but this field, however, will generate an e.m.f. between brushes 1 and 3 and these brushes will deliver current through Y-a-a-Y' in such a direction as first to

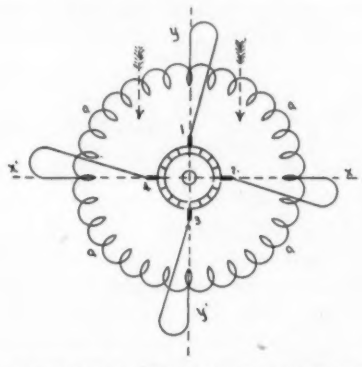


FIG. 2.—SIMPLE SELF-EXCITED ALTERNATOR.

oppose the residual magnetism and afterwards to reverse its directions. At the instant that the residual magnetism is zero, the only magnetism remaining in the machine is that due to the currents from the brushes 2 and 4; subsequently, this field combines with the vertical reversed field producing a resultant polar line between X and Y'. These operations being cyclic, they recur at periodic intervals and the phenomena become continuous. In other words, there is set up in the air gap of the machine a rotating magnetic field which cuts the conductors of the stator and is cut by the conductors of the rotor under such conditions that the e.m.f.'s generated between the brushes or the armature will be equal and opposite to the e.m.f.s generated between the terminals of the stator to which the brushes are connected. This consideration permits the frequency of self-excitation of the alternator to be calculated.

Assume the speed of rotation of the rotor to be N_1, and let the machine be a single magnetic circuit machine with X conductors in the rotor, and Y conductors on the stator; let the frequency of the rotating field be N; then, evidently, the effective frequency of the rotor current will be $N_2 = N_1 - N$. There are, therefore, X rotor conductors, cutting the flux of the machine at the frequency N_2, and Y conductors on the stator, cut by the same flux at the frequency N_1. The condition of equilibrium will be always fulfilled for a certain frequency of excitation such as will make

$$XN_2 = YN_1$$

from which we have

$$N_1 = N \frac{X}{X + Y}.$$

That is, the frequency of self-excitation is equal to the frequency of rotation times the turns of the rotor divided by the sum of the turns of both the stator and the rotor. This result is strictly true only when the resistance and leakage of the machine are zero and the influence of the distribution of the windings is negligible.

It is almost superfluous to note that the function of the commutator is to reduce the frequency of the e.m.f.s generated at the brushes to the same value as the frequency of the air gap flux of the machine and to make it independent of the actual speed at which the rotor conductors cut the flux.

Since interest is centered in a "low frequency" generator, it is well to consider the case where the frequency of self-excitation N is smaller than the frequency of rotation N_1, in which case the rotor is driven "above synchronism."

Consider the "fundamental" type of the machine, in which the stator and the rotor are provided with identical windings and, therefore, the frequency of self-excitation is equal to one-

half the frequency of rotation. Referring to Fig. 2, it is evident that the e.m.f.s generated in the rotor circuits between brushes are equal and opposite to the e.m.f.'s generated between the stator terminals, to which the brushes are connected. These e.m.f.'s of frequency N are in quadrature with the flux generating them, and are, consequently, in quadrature with the magnetizing currents flowing internally in the machine.

To overcome the ohmic drop of these magnetizing currents, it is necessary to apply to the energizing circuits of the machine e.m.f.'s in phase with such currents. This result is obtained by the arrangement shown in Fig. 3.

If the brushes of the armature are not directly connected to the stator terminals, but to a polyphase (rotating field) transformer, as shown in Fig. 3, the currents flowing from the rotor to the stator will energize the auxiliary transformer and will induce between the points *K-K'*, *J-J'*, *I-I'*, *L-L'*, e.m.f.'s which are sufficient to urge a current through the resistance of the magnetizing circuits. Instead of using a rotating field transformer, other types of exciting transformers may be used, their function being always to apply between each brush and the corresponding stator terminal, an e.m.f. in phase with the magnetizing current of the machine. Upon the magnitude of such e.m.f. will evidently depend the value of the magnetizing current. The same result can be obtained by omitting the auxiliary transformer and utilizing the windings of the machine itself for the production of the e.m.f. in phase with the magnetizing current.

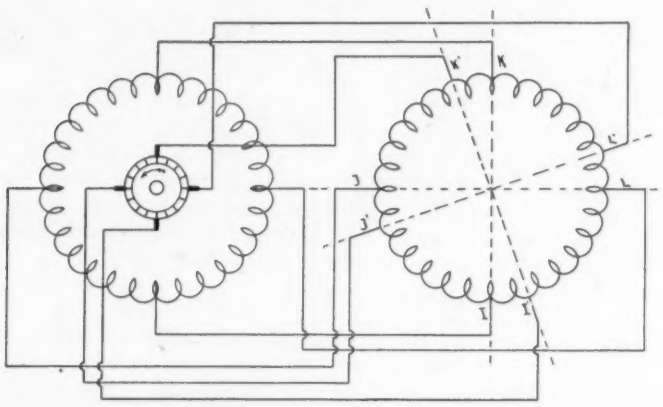


FIG. 3.—COMPENSATION FOR OHMIC RESISTANCE BY SEPARATE TRANSFORMER.

Referring to Fig. 4, the brushes on the rotor are shifted ahead, that is to say, in the direction of rotation, from the stator terminals by a certain angle, α. The air gap flux of the machine will then produce in the rotor circuits between the brushes, an e.m.f. which is equal in value to the e.m.f. at the terminal of the stator, but is shifted in phase by an angle, α. The e.m.f.s at the brushes and at the stator terminals will no longer neutralize each other, but they will cause a resultant e.m.f. which is in phase with the magnetizing current, as shown by the vector diagram of Fig. 5.

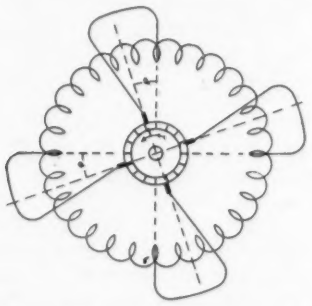


FIG. 4.—COMPENSATION FOR OHMIC RESISTANCE BY SHIFTING THE BRUSHES.

Let ϕ represent the air gap flux common to both the stator and the rotor. The flux, ϕ, produces at the terminal of the stator, an e.m.f. E_s of frequency N, and at the terminals of the rotor an e.m.f. E_r of frequency N, shifted behind E_s by the same angle α by which the brushes are shifted ahead of the stator taps. As far as the internal actions of the machine are concerned, the e.m.f. E_r assumes in the diagram the postion e_r. The resultant of E_s and e_r is "e." The e.m.f. "e" will send a current through the rotor and stator windings in series and will be consumed in the ohmic drop due to such current.

Neglecting the magnetic leakage of both members, this current will flow in the stator in the direction i_s and in the rotor in the direction j_r. The magnetization, due to the rotor current j_r, however, assumes the position i_r. The resultant of the m.m.f. due to i_s and of the m.m.f. due to i_r is the total magnetomotive force of the machine "i^0" which is effective in producing the flux ϕ and in phase with it. The magnetizing current flowing in the stator and rotor gives two ohmic drops, S and R, which combine with the induced e.m.f.s E_r and E_s, so that the effective resultant e.m.f. at the terminals of the stator will be the induced e.m.f. E_s plus the ohmic drop S; that is to say, E', and the effective resultant e.m.f. of the rotor will be E_r, (induced) plus E_r (ohmic drop), that is to say, E. The consequence is that by shifting the brushes of the armature ahead by an angle α, the machine can excite itself at a frequency following the law given above.

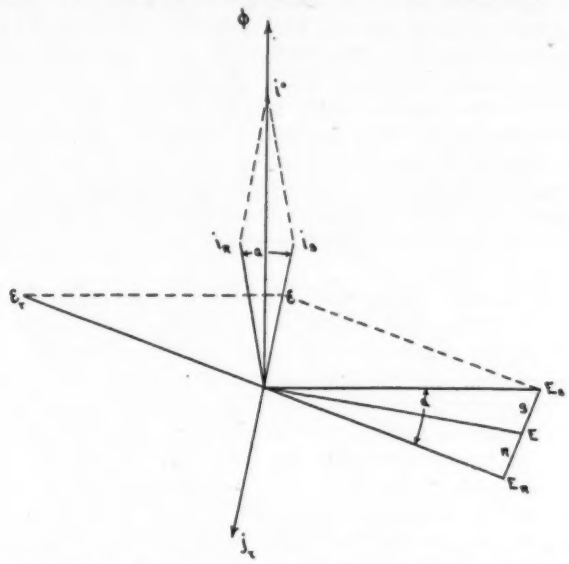


FIG. 5.—VECTOR DIAGRAM FOR ARRANGEMENT SHOWN IN FIG. 4.

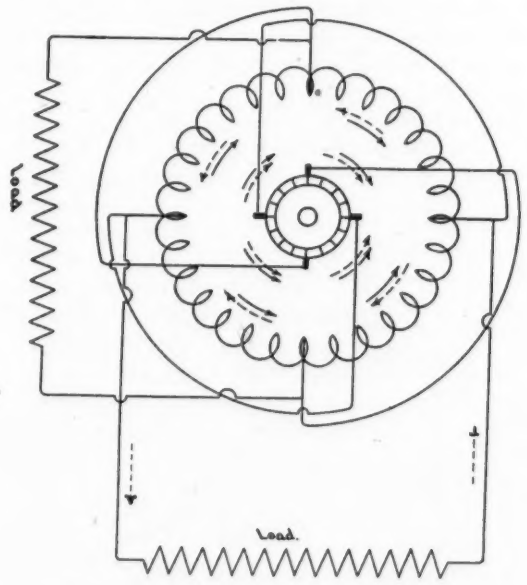
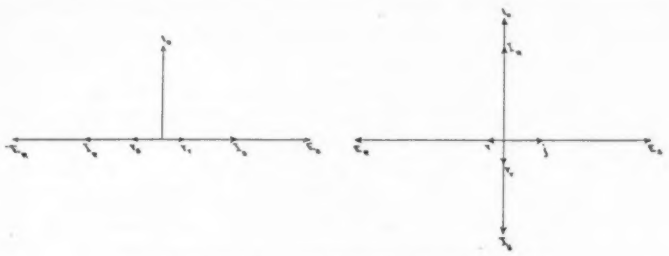


FIG. 6.—INFLUENCE OF LOAD ON LOW-FREQUENCY ALTERNATOR.

To study the influence of the load, it is well to consider first the case of the ideal machine with no resistance and no leakage, having an equal number of turns in the two members. The frequency of self-excitation is equal to one-half the frequency of rotation; the solid arrows in Fig. 6 represent the internal magnetizing currents at a certain instant. It is to be noted in Fig.

6 that all of the coils constituting the stator and the rotor windings are supposed to be wound in the same direction, while in the previous diagrams, in order to simplify the representation of the connections, the stator coils were supposed to be wound in a direction opposite to the rotor coils. If now, the machine is loaded (as represented in Fig. 6) it is evident that both the stator and the rotor will contribute an equal amount of current to the external circuit. The dotted arrows represent the direction of these load currents at a certain instant and show that the internal magnetizing effects of the stator and rotor *load* currents neutralize each other. Such an ideal machine would, therefore, carry any load of any character at constant potential. This tendency to deliver power to the load circuit from both members and to annul the magneto-motive forces of the load currents delivered from the stator by the m.m.f's of the local currents



FIGS. 7 AND 8.—INFLUENCE OF RESISTANCE.

delivered from the rotor, constitutes a most important and valuable feature of this alternator.

A complete analytical discussion of the influence of the ohmic and inductive resistance of the windings upon the characteristics of the machine would occupy too great a space for the present article. A clear idea of the quality of the phenomena involved can be obtained, however, by considering that the machine is in condition of equilibrium only when the "terminal" e.m.f.s between the brushes on the rotor is identical in value and phase with the "terminal" e.m.f.s between the stator taps to which the brushes are connected.

Consider a machine running at no load and self-excited, having an equal number of turns in the stator and the rotor circuits. In an ideal machine the load currents, as seen above, would not disturb its internal conditions; if, however, the windings possess ohmic resistance and magnetic leakage, the flowing of the load currents will, generally speaking, throw the system out of equilibrium and the conditions of equilibrium may be restored by the automatic readjustment of the variable factors in the operation of the machine. These variable factors are the frequency of self-excitation and the amount and phase of the currents exchanged between the stator and the rotor.

The above considerations may be applied to the study of the influence of the ohmic resistance upon the characteristic of the machine. In Fig. 7 E_s and E_r represent, respectively, the terminal e.m.f.s of the stator and of the rotor at no load. Neglecting the internal reactions due to the magnetizing currents and the angle of displacement of the brushes (which is always very small) the no-load magnetizing current of the machine assumes the position $I°$. When the alternator is loaded with a current I at unity power factor, a current I_s tends to flow through the stator windings and a current I_r tends to flow through the rotor windings. The current I_s is equal to I_r and equal to $\frac{1}{2} I$. The current I_s, however, will give an ohmic drop represented by r_s and the current I_r will give a drop represented by r_r. If the ohmic resistance of the stator is equal to the ohmic resistance of the rotor, the ohmic drop r_s is equal to the ohmic drop r_r. The terminal e.m.f. of the stator will be $E_s - r_s$ and the terminal e.m.f. of the rotor will be $E_r - r_r$. The two terminals e.m.f.s are then equal and in proper phase when the machine is loaded and the condition of equilibrium is not disturbed. If, however, the resistance of the stator is larger than the resistance of the rotor, then r_s is larger than r_r and the terminal e.m.f.s of the stator would be smaller than the terminal e.m.f.s of the rotor. The equilibrium is, therefore, disturbed and some correcting phenomenon will take place. In the case assumed above, the frequency of self-excitation will increase in order to make the value $E_s - r_s = E_r - r_r$. In conclusion, the frequency of self-excitation of the machine will increase at non-inductive load when the resistance of the stator is higher than the resistance of the rotor. If the machine is not wound with the same number of turns in the rotor as in stator, but the number of turns of the stator is, for instance, double the number of turns of the rotor, then the frequency of self-excitation at no load will be one-third of the frequency of mechanical rotation. If the machine is loaded with the current I at unity power factor, this current will split in two parts, one part, $I_s = \frac{I}{3}$, will flow through the stator and a part $I_r = \frac{2}{3} I$, will flow through the rotor.

It is evident that because $I_s = \frac{I_r}{2}$ and the number of turns of the stator is double the number of turns of the rotor, the m.m.fs. due to the load currents I_s and I_r neutralize each other (leakage being neglected). Furthermore, the stator ohmic drop will be equal to the rotor ohmic drop when the stator resistance is double the resistance of the rotor. Therefore, when the ratio of the resistance of the stator and rotor is equal to the ratio of their turns, the frequency of the machine does not change at a unity power factor load.

The influence of the resistance at a zero power factor load is shown in Fig. 8, where the same symbols represent the same quantities as in Fig. 7. The ohmic drops r_r and r_s are in quadrature with the terminal e.m.fs. E_s and E_r. The equilibrium is restored by the flowing of a current "j" in phase with E_s which induces at the terminals of the stator and rotor, e.m.fs. respectively opposite in direction to r_s and r_r. If the resistance of the stator is different from the resistance of the rotor a redistribution of the load currents and a change in frequency will occur. It is to be noted that the ohmic drop of the current "j" ("r") *assists* the e.m.f of the rotor and *opposes* the e.m.f. of the stator, and affects the frequency of the machine.

Fig. 9 gives an idea of the effect due to magnetic leakage when the machine is loaded with a unity power factor current. The vectors e_s and e_r are the leakage e.m.f's due to the currents I_s and I_r in the stator and the rotor. The current "j" opposite in direction to the magnetizing current will flow and balance by its ohmic drop "r," the leakage e.m.fs. e_s and e_r. If the leakage reactances and resistances of the two members are different, a redistribution of the load currents and a change in the frequency of self-excitation will again occur.

Fig. 10 represents the effect of leakage when the machine is loaded with wattless current. The leakage e.m.f. of the stator due to the wattless load current directly *opposes* the terminal e.m.f. of the stator while the corresponding leakage e.m.f. of the rotor *assists* the terminal e.m.f. of the rotor. A pronounced

FIGS. 9 AND 10.—INFLUENCE OF LEAKAGE REACTANCE.

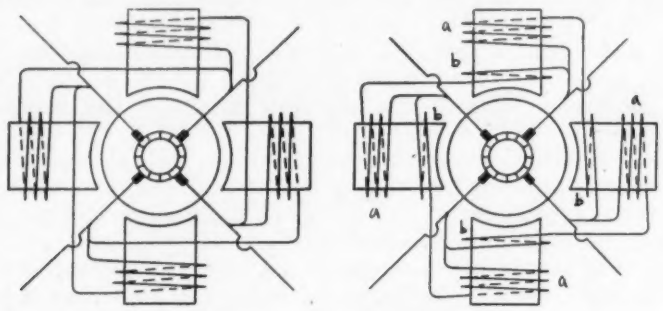
change in frequency is then necessary to equalize the terminal e.m.f. of the two members.

A long series of tests on experimental machines of this kind has shown that by arranging and proportioning the relative values of the ohmic and inductive resistances of the stator and rotor windings, it is possible to give to the alternator different characteristics and to keep the frequency of self-excitation practically constant.

An increase of resistance in the stator windings improves the regulation of the machine at wattless loads and the introduction of an external inductive resistance in the rotor circuit improves the regulation at a unity power factor load. The

action of this external inductive resistance is to counter balance the effects of the leakage of the rotor windings; in fact, the magnetizing currents of the rotor produce across the external inductive resistance, an e.m.f opposite in phase to the e.m.f. generated in the rotor by the same currents.

Another way of "compounding" the machine is to provide the stator with auxiliary coils traversed by the load currents; it is evident that the compounding actions of such coils depends not only upon their number of turns, but also upon their angular position. The same result can be obtained by tapping off the stator winding at equidistant intervals and taking the load from

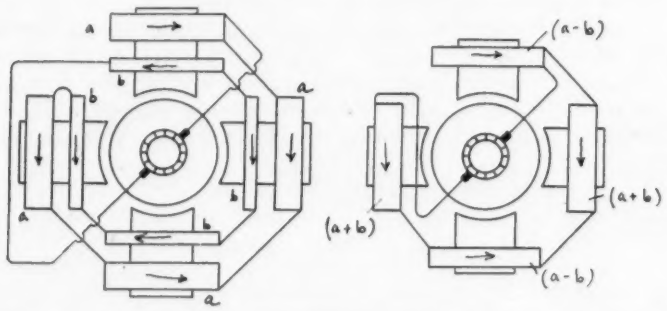


FIGS. 11 AND 12.—LOW-FREQUENCY ALTERNATOR WITH PROJECTING POLES.

the stator taps, which are displaced by a pre-determined angle from the taps connected to the rotor brushes.

It is to be remembered that this low-frequency machine was devised by Mr. Stanley to excite his "image current" type of alternator, and that one of the peculiar features of the system was to have the characteristics of the exciter complementary to the characteristics of the alternator. Although by the use of compounding coils and by the proper adjustment of the time constants of the stator and the rotor, any desired variation in the characteristics of the low-frequency generator can be obtained; it was found in practice that a machine of this type, if properly designed, could be used to excite an image current alternator without employing any external ohmic or inductive resistance, or any other auxiliary compounding device.

To close this outline description of the low-frequency alternator, it is well to mention another form of the machine which has given very good practical results. In this embodiment of the apparatus, the stator is not a slotted ring provided with a distributed winding, but is similar in construction to the field core of a direct-current machine, that is to say, it has salient,



FIGS. 13 AND 14.—LOW-FREQUENCY ALTERNATOR WITH PROJECTING POLES.

laminated poles and concentrated windings around each pole. Referring to the case of a two-phase, two-pole machine, the rotor is provided with four brushes in the usual manner, and the stator with four salient poles, each pair of opposite poles constituting one phase of the system.

Fig. 11 gives the connections for the self-excitation of this type of machine when the ohmic and inductive resistance of the windings is zero. The mechanism and the laws governing the excitation are identical with those explained in the case of Fig. 2. To overcome the ohmic resistance of the circuits, the "deflecting" coils "*b*" are connected in series with the main coils, "*a*," as shown in Fig. 12. It is clear that the e.m.f. across the coils "*b*" is in quadrature with the e.m.f. across the coils "*a*," and produces the magnetizing current in the rotor and the stator, as seen above. The result is that the machine can be operated without displacing the brushes from the neutral space.

Fig. 13 shows a similar arrangement, and for simplicity the connections for only one phase are represented in the diagram. The coils "*a*" are the main energizing coils and the coils "*b*" are the "deflecting coils." The direction of the currents in the two coils "*a*" and "*b*" at top and bottom is opposite, while the directions of the currents in the coils "*a*" and "*b*" on each of the two horizontal poles is the same as shown by the arrows. Since all the coils "*a*" and "*b*" are in series, the fluxes produced by the current in them are in phase and give the vertical poles an m.m.f. equal to $(a - b)$ while in the horizontal poles the m.m.f. is $(a + b)$.

The equivalent of this arrangement is that shown in Fig. 14, where the coils "*a*" and "*b*" on each pole are compounded into a single coil of $(a - b)$ or $(a + b)$ turns, the coils being marked respectively $(a - b)$ and $(a + b)$.

The dissymmetrical construction of these symmetrically arranged coils results in a lack of coincidence between the axes of the stator field and the rotor field. On account of the difference in the number of turns in the stator coils the polar line is not in the center between any two adjacent polar projections, but is deflected backward against the direction of rotation. The effect of this distorsion is to produce an e.m.f. equal to the vector differences between the e.m.fs. produced in the rotor and the stator windings, and this resultant e.m.f. is in phase with the magnetizing currents and produces them, as explained above.

In each form of apparatus, no trouble whatever was experienced in the commutation of the low-frequency currents, the maximum frequency used being eight cycles per second.

Wave Lengths in Wireless Telegraphy.

By H. J. Round.

SOME time ago the author carried out a series of experiments on the effect of varying the wave length used between two wireless stations with land between them, the results of which experiments are outlined below.

The two stations used were 65 miles apart. The mast at each end was about 170 feet in height. Ten-inch spark coils and secondary batteries giving 65 volts only were available, and, in consequence, it was decided to use the single-circuit method of transmitting, usually called "plain aerial."

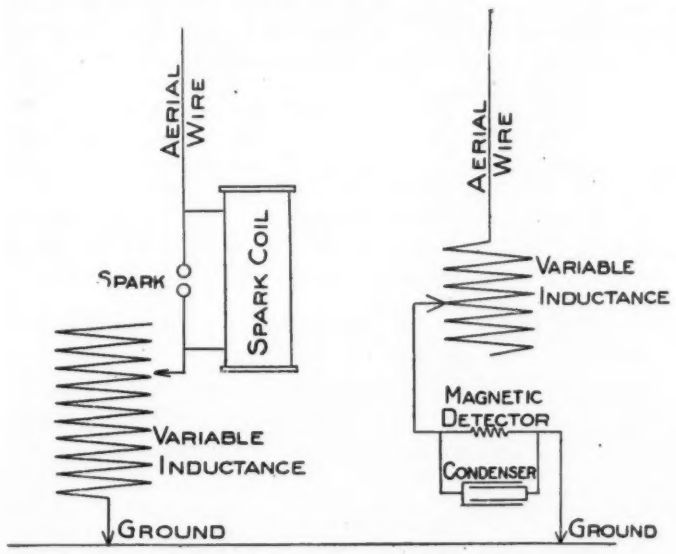
The aerial wire at the transmitting end consisted of a single vertical wire with four 180-foot extensions connected to its top and guyed out so as to be as horizontal as possible. The insulation of this aerial was as perfect as it is possible to make it—four or five lengths of 2-foot hard rubber rod being placed in series between the aerial and its support and guys. These rods were kept well oiled. When this aerial was connected to one terminal of the spark coil, and the other terminal grounded, a spark about 3 inches long could be obtained between spark balls 1 inch in diameter. The spark gave faint signals on the aerial wire at the receiving station.

At the receiving end a sensitive magnetic detector was used with a demagnetizing coil made of 10 feet of No. 36 wire. The receiving aerial consisted of three vertical 180-ft. wires in multiple and these were connected to the detector through a variable inductance coil. This coil consisted of 200 turns of No. 16 c.c. wire closely wound in one layer on a rectangular glass core about 30 inches in circumference. The wire had a stripped place every five turns to enable the inductance to be varied. The other side of the detector coil was grounded, and in shunt with the coil was placed a condenser whose capacity could be varied from nothing up to 1-100 m. f. The complete connections are shown in Figs. 1 and 2. No attempts were made at the transmitting station to measure the actual transmitted wave length, but the length of wave emitted with no inductance in series with the aerial and spark gap was probably of the order of 2,000 feet.

It was determined to investigate the effect of lengthening the wave at the transmitting end by adding inductance between the

spark gap and ground, the inductance being placed there because of ease of insulation. An inductance consisting of 100 turns of No. 16 wire was wound on a foot-square box and the wire spaced ¼ in. to prevent cross sparking. This inductance was placed in the transmitting circuit (Fig. 1), turn by turn, and the maximum value of signals at the receiving end noted. As turns were added in the transmitter the inductance and the capacity of the shunt condenser in the receiving circuit had to be increased to obtain the maximum signals. The strength of maximum signals gradually increased, until 40 turns were in the sending circuit; more than 40 turns decreased the signals. With 40 turns in the transmitter, about 130 turns of receiving inductance were necessary, and a shunt capacity of about 1-200 m. f. was required.

The tuning at this point was very sharp and distinct, and the signals were very strong and readable. A curious effect was noted at the sending station. When the inductance was omitted the spark was white and clear, but as the inductance was added it became redder and more like an arc, and with 40 turns in circuit, it was necessary to remove the spark balls and obtain a point spark to keep the signals clear. The same effect can be noted with a Leyden jar discharge, as the inductance in the discharging circuit is increased. With jars it is no doubt due partly to leakage, but with the aerial the only explanation is that it was due to brush discharge, as the insulation was very high.



FIGS. 1 AND 2.—TRANSMITTER AND RECEIVER CIRCUITS.

The experiments were repeated with an 8-wire extension aerial; also with a 4-wire extension aerial with 300-ft. extensions. Maximum signals were found with considerably less inductance, but curiously the maximum at the receiving end indicated that the best wave length was about the same. A wireless station 120 miles away, over sea, reported that the signals instead of increasing decreased with the increase of wave length, until when the signals were a maximum over land they were unreadable over sea.

These results seem to show distinctly that over land an increase of wave length more than compensates for the decreased radiation produced by the increased wave length and the added impedence. The decrease in radiation no doubt also accounts for the very marked tuning noted at the receiving end.

Throughout the experiments a current of about 10 amperes at 65 volts was used.

Self-Reducing Resistance.

For the purpose of starting almost all types of motors it is desirable to employ a large resistance when the switch is first closed and to decrease the resistance as the speed of the motor increases. The decreasing of the resistance has frequently been accomplished by some mechanical device operated manually or automatically. During the last few years several attempts have been made to obtain as a material for motor starters some substance which possesses a high resistance when cold and a low resistance when hot. One of the best substances for this purpose is magnetite, which possesses a large negative temperature-resistance coefficient. A patent granted August 21 to Mr. E. Schattner describes a resistance unit which is formed of finely pulverized magnetite and finely pulverized mica mixed in certain proportions. It is stated that the mixture of mica and magnetite is preferable to pure magnetite because the resistance of the latter material decreases more rapidly than the counter e.m.f. of the motor rises under ordinary service conditions, while the time rate of change of the resistance of the mixture may be varied to any desired extent by changing the proportions of component elements. The mixture is contained in a metal tube lined with asbestos or mica. Metal end plugs which serve to compress the material within the tube, are employed as terminals for the resistance unit.

Wiring Residences for Intercommunicating Telephones.

The Bell Telephone Company of Philadelphia has issued a bulletin for the use of architects and builders, giving methods of

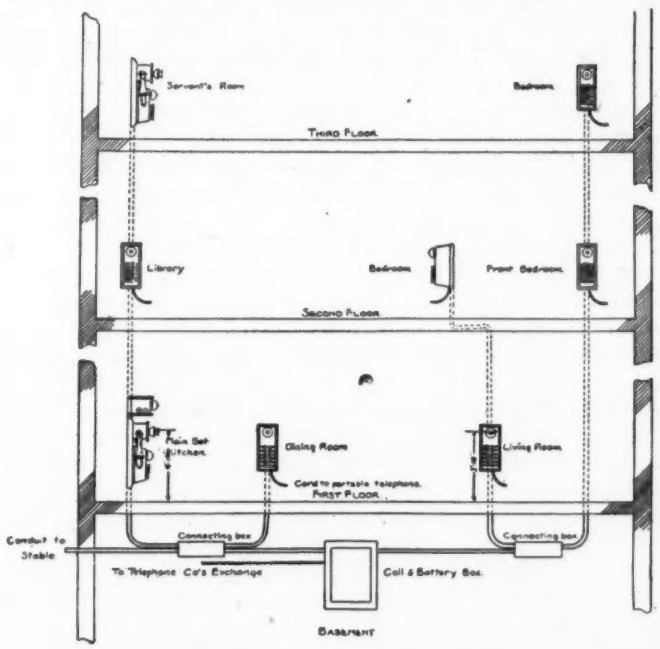


FIG. 1.—ELEVATION SHOWING WIRING.

wiring residences for exchange and intercommunicating telephone service. The introductory paragraph points out the advantages

FIG. 2.—PLANS OF FIRST AND SECOND FLOORS.

of the interior telephone service, and it is here stated that since the introduction, about a year ago, of the combined intercommuni-

cating exchange system described, over 1,200 installations have been made in Philadelphia. The specifications include information concerning all of the details of installation. In the case of conduit wiring, ¾-in. is recommended for from 5 to 10 stations; 1 in. for from 10 to 20 stations; and 1¼ in. for from 20 to 30 stations. The heights of outlet from the finished floor given are, for wall telephones, 4 ft. 10 in.; for portable telephones, 3 ft. 10 in.; for exchange bell at main station, 6 ft. 6 in.; for extension bell, 8 in. The accompanying illustrations, giving methods of wiring, are reproduced from the circular.

Installment Payment Plan of Residence Wiring as Worked Out at Cleveland.

In the Electrical World of July 7, 1906, page 24, mention was made of a plan inaugurated by the Cleveland Electric Illuminating Company for the wiring of residences, payments to be made on the installment plan. Full details of this plan were not given in that article for the reason that it was at that time undergoing some changes and being worked up in more perfect form. The first contract and schedule covered only a limited number of conditions which the company had to meet when its solicitors got actively at work in the field. Since then a very carefully considered contract and schedule has been arranged and was described by Mr. M. E. Turner, of the Cleveland Electric Illuminating Company in a paper before the Ohio Electric Light Association, August 22, 1906. Mr. Turner's paper, together with the complete schedule of prices and form of contract, is therefore given here. It may be said by way of explanation that the schedule as it stands does not include the cost of fixtures, but simply the cost of wiring, to which may be added the cost of hardware according to the figures given in connection with the schedule. Arrangements are being made whereby the fixtures as well as the wiring can be paid for in installments. Mr. Turner's paper was as follows:

Nearly every electric supply station, large or small, has to meet keen competition in securing residence business. In the majority of cities gas and other illuminants offer a cheaper means of lighting the home than does electricity at the generally prevailing house rates. To offset this disadvantage in price where it exists, electricity can be used in the home for many purposes other than lighting; further, the home can be much better lighted. Until it is brought to their attention, many people have not considered that they toil in order to provide a comfortable home for themselves and their families, and that the time when it is possible for most of them to enjoy their homes is in the evening when artificial light is necessary. This fact is the reason why we have every encouragement for believing that electric light must be the universal light of the home; and if we would get this business now, it is for us to bring the fact clearly before all people. Every person should be made to feel that electricity in the home is far more necessary to them than surplus furniture, pictures or many other household articles; that it is one of the things essential to a comfortable home, and that the expense for putting it in their houses should weigh less than the expense of putting in so many windows, because of its higher value to them; and that the amount of expense for using it for different purposes should be allowed for as for one of the necessities of life and not as an unimportant item to be figured at 2 or 3 per cent of their income.

Electricity in the home has its most important function in the lighting, but not necessarily its largest use. It can, and should even now, be used for auxiliary heating and cooking; for cooling in summer and for running the sewing machine at all times; for grinding the meat and polishing the silver; for ironing, and so on in numerous ways.

If we would secure this business to ourselves, we must bring a recognition of the worth of our goods to all; and this is accomplished by effective advertising. Whether we advertise by personal solicitation or through literature, or both, we must, to have our advertising most effective, (1) attract attention, (2) interest, and (3) create a desire to possess. Further than this to have the largest success, we must devise a plan for installing the necessary wires for our current that will make it possible for every householder to gratify the awakened desire to use electricity.

The greatest possible number of customers for an electric supply station in any city is the residence customers, because there are many times more homes than there are stores and factories. But in nearly every city by far the largest percentage of these residences do not use electricity, because so many of the houses were built before electric service was, or seemed to be, available to these builders.

It is true that the present income derived from a few houses necessitating large line investments is unprofitable; but with a service into every residence along the electric lines, the aggregate revenue would be large and the business profitable.

In Cleveland the possibilities in this residence load have been recognized and a plan devised by the illuminating company that puts it within the reach of nearly every householder to install electric service.

At the present time this plan is used there only in favor of detached houses now using illuminants other than electricity. New houses, flats and apartment houses are now generally wired in any event. The older homes are nearer the center of the city and necessarily lie along the electric mains to serve the new.

The plan adopted by the Cleveland company is, soliciting among the older houses for electric service, and the material inducement is in offering a contract for the installation of the wiring and fixtures in which the installation is paid for by the customer on the installment plan. Payments, however, are not made to the company, nor is the illuminating company a party to the contract except as an agent soliciting the business for a contractor afterwards named by the company.

The illuminating company undertakes to have the contract accepted by a contractor, and immediately after mails a duplicate signed and accepted contract to the soon-to-be consumer of electricity.

Following is the form of contract now used by the Cleveland company:

RESIDENCE WIRING CONTRACT.

The contractor agrees to do all work specified, listed or shown in accordance with the specifications and schedules attached, and made a part of this agreement.

The contractor further agrees that during the performance of this work he will indemnify and save harmless the purchaser in whose residence the work herein specified is to be performed, from any and all damages, costs, attorney's fees whatsoever, which may arise by reason of injury to person or property, resulting from negligence or carelessness in the performance of this work.

The contractor agrees to commence the work within 24 hours after receipt of notice that service has been installed.

The contractor agrees to have all work called for under the specifications and schedule completed within one week after the work has been started.

The contractor further agrees to receive, and the purchaser agrees to pay, the sum of ———— dollars. This sum is to be full compensation to the contractor for all labor and material necessary for the completion of all work specified, listed or shown in the specifications and schedule attached and made a part of this agreement.

The said sum of $———— is to be paid to the contractor in the following manner:

One-fourth or $———— on completion of work, and not less than 10 per cent of the balance, or $———— per month thereafter, until the terms of this agreement shall be satisfied, provided all the terms of this agreement have been fulfilled. From this balance any sums accruing from defaults are to be deducted.

Specifications.

All work specified, listed or shown in these specifications, and all work necessary to the complete finish of the work so described or shown is to be executed in a thoroughly substantial and workmanlike manner.

All material used and work done under these specifications must be in accordance with the approved rules and regulations of the National Electric Code.

The contractor is to give his personal superintendence and direction to the work, and he is to furnish all transportation, labor, material and utensils needful for performing his work in the best manner according to the true intent and meaning of these specifications.

The contractor shall give to the proper authorities all requisite notices relating to the work in his charge, and be responsible for any accidents resulting from either contract or extra work under his charge.

The contractor shall at all times cover and protect his work, and the materials to be used therein, from damage by weather or otherwise, and shall repair and make good any damage thus occurring.

Outlets

No. of Outlets	CLASS A 1st Floor, Any Wood 2nd Floor, Soft Wood Single Flooring 2nd Floor Hall, Any Wood	CLASS B 1st Floor, Any Wood 2nd Floor, Soft Wood Double Flooring 2nd Floor Hall Any Wood 3rd Floor, Soft Wood	CLASS C 1st Floor, Any Wood 2nd Floor, Less than one-half Hard Wood 3rd Floor, Soft Wood	CLASS D 1st Floor, Any Wood 2nd Floor, more than one-half Hard Wood 3rd Floor, Any Wood
17	$ 34 00	$ 48 00	$ 55 00	$ 65 00
18	35 50	49 75	57 00	67 25
19	37 00	51 50	59 00	69 50
20	38 50	53 25	61 00	71 75
21	40 00	54 75	63 00	74 00
22	41 50	56 50	65 00	76 25
23	43 00	58 25	67 00	78 50
24	44 50	60 00	69 00	80 75
25	46 00	61 75	71 00	83 00
26	47 50	63 50	73 00	85 25
27	49 00	65 25	75 00	87 50
28	50 50	67 00	77 00	89 75
29	52 00	68 75	79 00	92 00
30	53 50	70 50	81 00	94 25
31	55 00	72 25	83 00	96 50
32	56 50	74 00	85 00	98 75
33	58 00	75 75	87 00	101 00
34	59 50	77 50	89 00	103 25
35	60 50	79 25	91 00	105 50
36	62 00	81 00	93 00	107 75
37	63 50	82 75	95 00	110 00
38	65 00	84 50	97 00	112 25
39	66 75	86 50	99 25	114 75
40	68 50	88 50	101 50	117 20
41	70 25	90 50	103 75	119 70
42	72 00	92 50	106 00	122 20
43	73 75	94 50	108 25	124 70
44	75 50	96 50	110 50	127 20
45	77 25	98 50	112 75	129 70
46	79 00	100 50	115 00	132 20
47	80 75	102 50	117 25	134 70
48	82 50	104 50	119 50	137 20
49	84 25	106 50	121 75	139 70
50	86 00	108 50	124 00	142 20
51	87 75	110 50	126 25	144 70
52	89 50	112 50	128 50	147 20
53	91 25	114 50	130 75	149 70
54	93 00	116 50	133 00	152 20
55	94 75	118 50	135 25	154 70
56	96 50	120 50	137 50	157 20
57	98 25	122 50	139 75	159 70
58	100 00	124 50	142 00	162 20
59	101 75	126 50	144 25	164 70
60	103 50	128 50	146 50	167 20

Hardware

Push button switches, each,	$1 15
Push button 3-way switches, per set of 2 switches,	3 50
Rotary switches, each,	75
Rotary 3-way switches, per set of 2 switches,	2 50
Porcelain base switches, each,	25
Porcelain base Edison receptacles, each,	25
Bryant flush plate receptacles, each,	75
Chapman flush plate receptacles, each,	1 05
Drop lamp key socket, each,	30
Drop lamp chain socket, each,	45

All openings for switches, receptacles, drop lamps and fixtures are considered as outlets and based on a unit price for houses of different classes of construction. The cost of switches, receptacles and drop lamps should be added to the price of outlets, and this sum will be the contract price for all labor and material necessary to complete the work as outlined in the schedule.

All extra outlets, switches, receptacles and drop lamps are charged for at the rates according to the class of house for which the contract is written.

SCHEDULE OF PRICES OF OUTLETS AND HARDWARE.

Outlets or hardware not listed in the schedule will be installed by the contractor only on the written order of the purchaser, who agrees to pay for such extra work at the rates shown in Class ——, of the price list form ——— attached.

All wires must be concealed between the floors and walls except in the basement, where moulding must be used; or where it is impossible to conceal the wires over the ceiling of the attic, moulding must be used. All wires to side outlets in the attic to be concealed.

The entire work must be done in accordance with the approved rules and regulations of the National Electric Code.

The contractor must pay the cost to the purchaser, of a certificate of approval from the Cleveland Inspection Bureau.

The contractor must remove and relay all carpets, rugs and flooring necessary to install the wires.

Where switches are specified under the schedule, the contractor must provide and install a ——— switch at each switch outlet

	CLASSIFICATION OF LIGHTS										CLASSIFICATION OF FIXTURES		
Location											Catalog Number	Number Lights	Price
Porch													
Vestibule													
Reception Hall													
Reception Room													
Living Room													
Library													
Dining Room													
Lavatory													
Pantry													
Kitchen													
Basement													
Rear Hall													
Upper Hall													
Upper Rear Hall													
Bath													
N. E. Chamber													
S. E. Chamber													
N. W. Chamber													
S. W. Chamber													
Chamber													
Chamber													
Closets													
Totals.													

SCHEDULE OF LIGHTS AND FIXTURES.

except in basement, attic, clothes closets and similar places where porcelain base snap switches must be used.

The contractor must provide and install all necessary cut-outs. All cut-outs to be located in a cabinet. Cabinets to be lined with asbestos and finished to match existing woodwork.

The contractor must provide and install ——— flush plate baseboard receptacles at each receptacle outlet, as outlined under the schedule, and as located by the purchaser.

The contractor must provide and install all drop lights complete without lamps.

The contractor must run two wires from the point where the service enters the building to the center of distribution, and make all necessary provisions for the installation and connection of meter.

The purchaser must locate all outlets for fixtures, switches, receptacles and drop cords before wiring is started.

The Series Luminous Arc and Rectifier System.

At the Ohio Electric Light Association Convention, August 21 to 23, Mr. N. R. Birge described the luminous arc lamp of the General Electric Company in its latest form, and also gave details of the rectifier outfit for supplying direct current to these luminous arc lamps from an alternating-current supply, this being the first detailed description published of the lamp and auxiliary appliances in their present form. The lamp is illustrated in Figs. 1 and 2. The connections of the lamp are shown in Fig. 3.

The main frame of the lamp consists of a single large tube which acts as a chimney for carrying away the fumes of the arc. At the top of the lamp are wind shields which prevent downward drafts into the tube.

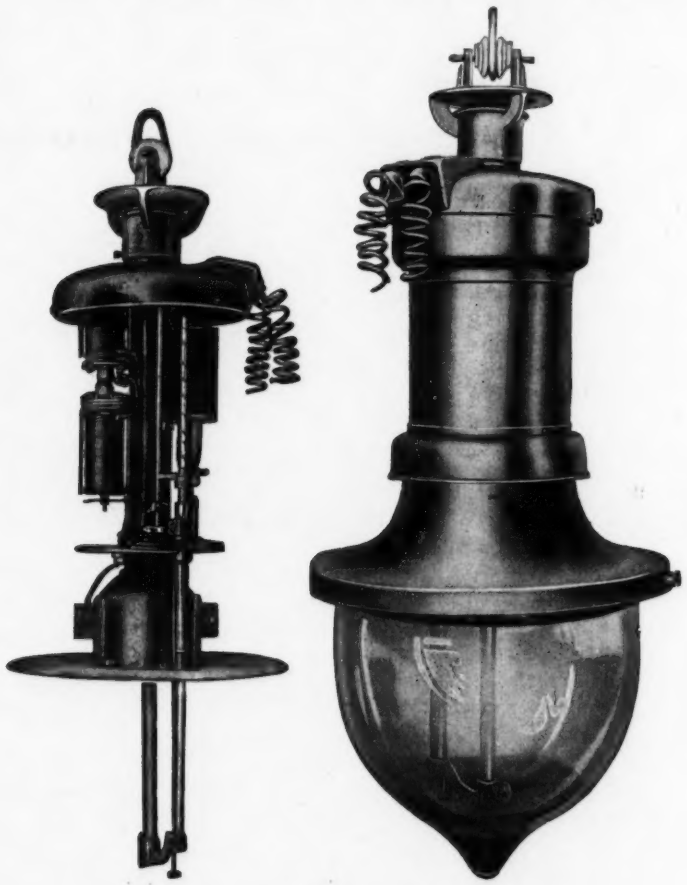
The electrodes of the luminous arc lamp differ entirely from ordinary carbon arc lamp electrodes. The upper electrode consists of a bar of hard-drawn copper supported by iron wings. The lower electrode is made of specially prepared composition contained in an iron tube 5/8 in. in diameter by 8 in. long.

A horizontal reflector is placed inside the globe and in close proximity to the arc and serves to throw an ample volume of

light below the lamp without interfering with the main distribution of light in the horizontal direction.

The casing is made of solid copper with oxidized finish and supports a closed base outer globe, the lower part of which is frosted to insure an even distribution of the light directly beneath the lamp.

The mechanism is without floating parts and when the lamp is out of circuit its electrodes are separated with the lower electrode carrier detained by a stop which holds the tip of the lower electrode at a fixed distance from the upper electrode. When the current is thrown on, the pick-up by the starting magnet brings the lower electrode into contact with the upper electrode. This operation allows the current to flow through the series magnet, thereby opening the circuit of the starting magnet, at the cut-out contact, allowing the lower electrode to fall, striking an arc. The lamp is then burning with the lower electrode carrier resting on its stop and with the series magnet holding the cut-out contact open. As the lower electrode is consumed the voltage across the arc rises, the shunt magnet (which is bridged across the arc) lifts its armature, closing the cut-out contact when the arc voltage has reached a predetermined limit. The closing of this contact cuts the starting magnet again into circuit, thereby picking up the lower electrode and starting the arc as before with the correct length of arc for proper operation.



FIGS. 1 AND 2.—SERIES LUMINOUS ARC LAMP.

The series magnet is of low resistance and causes a drop of only a volt or two between the terminals of the lamp and arc when the lamp is in operation. The lamp is so designed that only two single adjustments are necessary; the adjustment of the shunt armature to feed the lamp at the proper arc voltage, and the setting of the stop for the lower clutch to determine the proper length of arc.

The principal advantage of this lamp is its high efficiency, good distribution of light and low maintenance cost. Luminometer readings show that such a lamp consuming 310 watts at its terminals gives the same intensity of illumination at a distance of 309 ft. that a 480-watt, direct-current, series-enclosed arc lamp gave at a distance of 255 ft.; or, that the 480-watt, alternating-current, enclosed-arc lamp gave at 247 ft. The color of the luminous arc is pleasant for street illumination. The light has a spectrum which is practically the same as sunlight and as white as any commercial light in service to-day.

The maintenance cost of the luminous arc lamp is very low. The upper electrode is copper and the arc burns at a comparatively low temperature, which results in an average life of about 4,500 hours for this electrode and a practically negligible cost for renewal. The lower electrode has a burning life of from 150 to 175

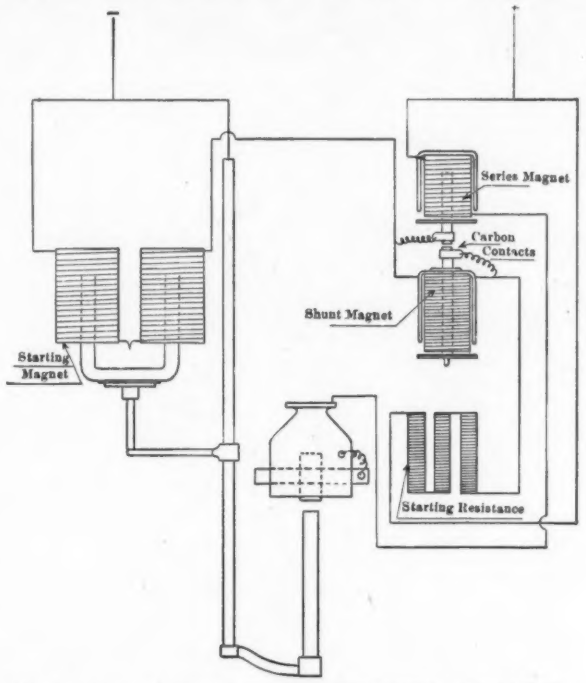


FIG. 3.—CONNECTIONS OF SERIES LUMINOUS ARC LAMPS.

hours, which allows one man to take care of and trim a much greater number of lamps than is possible with open or enclosed carbon arc lamps. This long burning feature and the fact that only one electrode must be renewed gives marked economy in maintenance.

The connections of the rectifier outfit for changing alternating

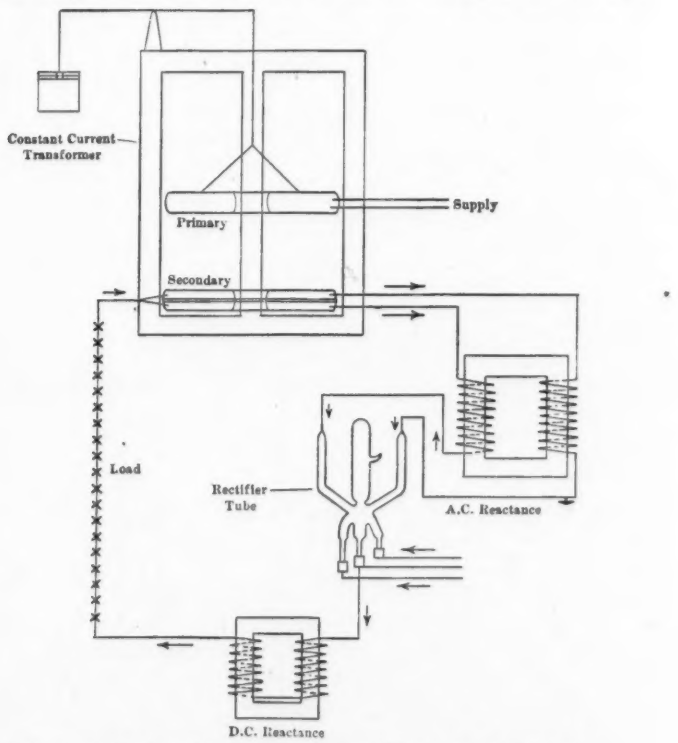


FIG. 4.—CONNECTIONS OF SERIES MERCURY ARC RECTIFIER.

to direct current to supply a series of luminous lamps is shown in Fig. 4. The primary windings of the transformer are connected to an alternating-current supply of practically any voltage. The secondaries are connected through small reactances to the anodes or alternating-current terminals of the rectifier tube. A tap at

the middle of the secondary connects the transformer with one end of the direct-current circuit on which the lamps operate.

The proper adjustment for current in the lighting circuit is obtained by small weights attached to the rocker arms which support the movable coils of the transformer. The transformer will regulate from full load to slightly below one-half load with constant secondary current.

The rectifier tube is supported on the panel in a movable wooden holder. The tube is put into operation by shaking it slightly, which causes a flow of mercury between the mercury starting anodes and the mercury cathode, thereby bridging the circuit and permitting a flow of current from the low-voltage exciting circuit connected to the starting electrodes. The breaking of this bridge causes the formation of a small arc at the bottom of the tube between the starting anodes and the cathode. With this small arc in operation the main arc can be established by closing the primary switch of the constant-current transformer, which throws the secondary of the transformer in circuit with the operating anodes of the tube.

With the tube operating at 4 amp. there is a drop equivalent to about 25 volts or a loss of 100 watts, which is constant at all loads. Under normal operating condition the average life of the tubes on 25, 50 and 75-light circuits is over 400 hours. Reports from commercial installations show that the maximum life reported is over 1,200 hours.

The paper concluded with information as to performance of a large number of these lamps in Portland, Ore., and Poughkeepsie, N. Y.

DISCUSSION ON SERIES LUMINOUS ARC RECTIFIER SYSTEM.

The paper by Mr. Birge on this subject was discussed at some length and some interesting figures brought out. Mr. Tait asked the proper height at which to hang magnetite arc lamps. Mr. Birge gave this as 20 to 25 ft. Mr. Birge being asked as to relative costs, gave the following figures. The rectifier tubes cost $20 net after the rebate for returned tubes has been deducted. The maintenance cost of an enclosed 480-watt series arc lamp burning 4,000 hours per year for trimming, carbons and globes in some of the large central stations of the country is about $4.25. The cost of the luminous arc lamp on the same basis for trimming, carbons, electrodes, and outer globes is $2.95 per lamp per year. Tube renewals figured on the basis of $2.28 per lamp per year would bring up the cost to $5.23 per lamp per year for a 50-light outfit with a tube life of 700 hours. With the cost of energy at 1.5 cents per kw-hour, the energy to supply the 480-watt enclosed series arc lamp would cost $33.40 per year. The energy to supply the magnetite luminous arc would cost $22.14, making a saving in energy of $11.26. Deducting from this the extra maintenance cost of the luminous arc lamp or 98 cents would leave the balance in favor of the luminous arc $10.28. The efficiency of the rectifier outfit is about 90 per cent, that of a Brush arc machine wound for 4 amperes about 80 per cent.

Mr. Grabill, of the Ashland Gas & Electric Light Company, said that his company had changed 90 open-arc lamps to magnetite lamps. Carbons for the open arcs used to cost $200 per year. He had purchased $50 worth of electrodes for the magnetite lamps which, from present indications, would last 14 months. Trimming labor had been greatly reduced, as had also the fines for city lamps being out. In summer lamps are trimmed once in two months and in winter once a month. Lamps burn until midnight.

Variable-Speed, Direct-Current Motor.

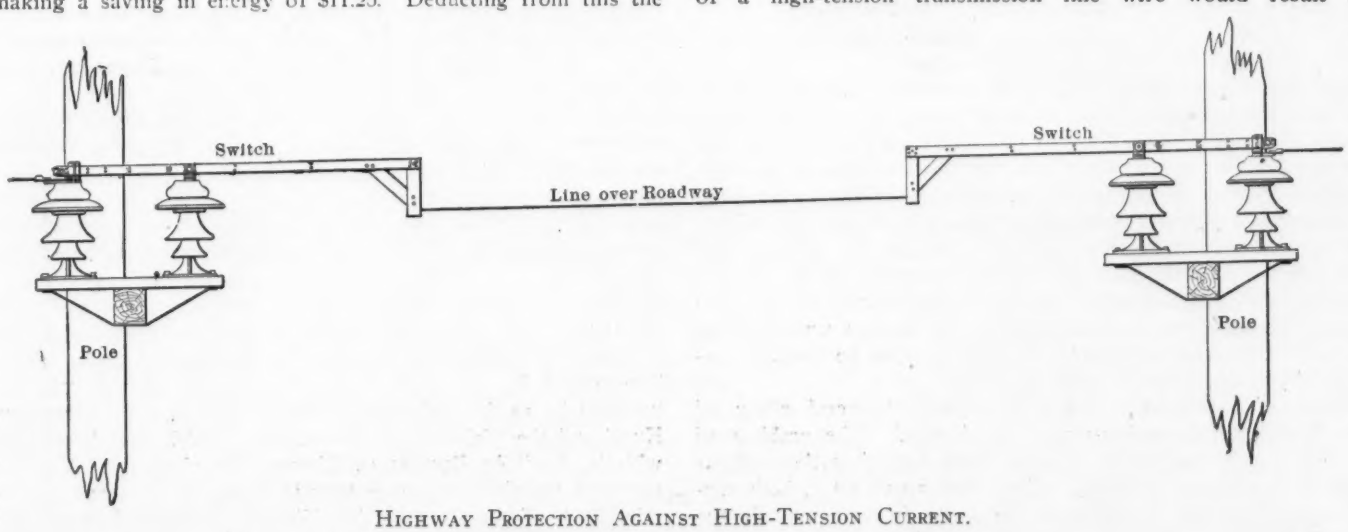
Of the many forms of variable-speed, shunt-wound, direct-current motors which have been introduced recently one of the most interesting is found in the machine devised by Mr. John C. Lincoln, as described in our issue for April 7, 1906. A patent issued to Mr. Lincoln on September 4 discloses numerous constructive details of this type of motor. The machine is provided with a frusto-conical armature equipped with means for securing its longitudinal withdrawal from the field structure whereby the armature speed is varied. Sparking at the brushes at high speeds is avoided by associating with the field structure narrow polar extensions lying in the direction of withdrawal of the armature and suitably advanced with respect to their corresponding poles of the motor as to cause the generation of an electromotive force successively in the coils of the armature at the moment of commutation in oppositon to the armature current. It is stated that best results are obtained when the field windings and magnetic bodies of the polar extensions are so proportioned as to secure the substantial magnetic saturation of the extensions at full load and high speed. It is claimed that motors of the above type may be constructed having as wide a range of speed as one to six, while reducing the weight of the motor more than half as compared with the usual commercial structures. The decrease in weight is attributed to the greatly increased number of turns which may be used upon the armature as compared with a motor without polar extensions in which the change in speed is obtained by varying the field strength.

LETTER TO THE EDITORS.

Protecting Highways Against High-Tension Transmission Line Breakage.

To the Editors of Electrical World:

SIRS:—The accompanying sketch shows a scheme for protection of life on the highways over which high-tension transmission lines pass. Usually where no protection is afforded the breaking of a high-tension transmission line wire would result in kicking up the dust around the spot where the line fell and killing anyone coming in between the wire and the ground before the breakers at the station would act. By means of the device shown herewith, the circuit would be broken almost instantly, or at any rate the falling wire would be dead before it reached the ground. On the poles on each side of the roadway two standard insulators are fixed to the cross arm for each wire of the high tension line. Pivotted to one insulator is a switch of the shape shown making connection with jaws at-



HIGHWAY PROTECTION AGAINST HIGH-TENSION CURRENT.

tached to the other insulator and connected to the line. The circuit is completed through the switches and the short length of wire across the roadway, the tension on this wire serving to keep the switches closed. If now the line across the roadway should break this tension would be released and the weight of the copper, together with the heavy extension arm of the switch would result in opening the switch on either side of the roadway instantly. A spring might also be added so as to make the opening of the switch more positive.

Toledo, Ohio. John Manning.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Interpole Machines.—Oelschlaeger.—Interpole construction represents not only an electric improvement, but also practical and commercial advantages. The latter are indicated by the fact that, with the same weight, it is possible to increase the capacity of the machine by about 35 or 40 per cent. In comparison with this advantage, the additional cost of the interpoles themselves is of little significance. These advantages can be fully utilized only as long as the permissible increase of temperature of the machine permits the increase of capacity; that is especially with large and medium-sized machines running at not too low a speed, in which case efficient ventilation is always possible. With smaller machines the increase of temperature soon puts a limit to further increase of capacity. This is the reason that for capacities of from 10 to 50 hp interpole construction has been applied only in exceptional cases, for instance for motors with a speed variable within very wide limits, etc. The author shows, however, in a general way that even with such small machines the use of interpoles offers great practical and commercial advantages since this method permits simplification of construction in general.—*Elek. Zeit.*, August 23.

Compounding Alternators.—Roth.—The first part of a highly theoretical paper on compounding of alternators. The method discussed by the author is shown in Fig. 1, where *G* is the alternator, *Td* and *Ts* being two transformers supplying current to the two converters, *Cd* and *Cs*. The primary coils of *Td* are directly connected with the terminals of the alternator, while the three-phase currents of the alternator flow through the primary winding of the second transformer, *Ts*. The converters may be excited in different ways—they may be self-excited, or may be separately excited, etc. In the illustration the primary field coils of the converters are connected in series, and they are in parallel with the primary winding of the alternator, *G*. The author discusses the mathematical theory of such arrangements with the aid of diagrams. The paper is to be continued.—*L'Eclairage Elec.*, August 18.

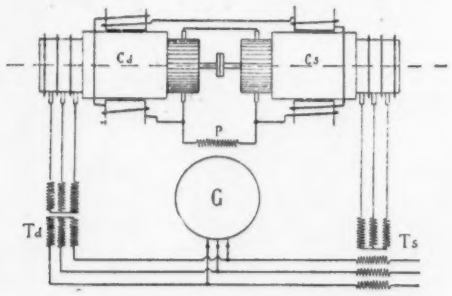


FIG. 1.—COMPOUNDING ALTERNATORS.

Alternating-Current Theory.—Perret.—A "general study of the theory of alternating-current machinery." The problem of electric machines considered as a whole comprises the analysis of the phenomena of induction in a stator and rotor, both supplied with several currents of the same frequency, while the amplitude, phase displacement and angle of phase may have any values; in other words, it is the problem of the machine with elliptic field, of which all commercial machines represent special cases. For instance, the polyphase machine is that particular case in which the different acting currents are equal in amplitude and have angles of phase corresponding to those of a regular polygon. Single-phase machines are machines with an elliptic field. The direct-current machine may be viewed under the same principle if one considers it as the special case of a single-phase machine of zero frequency. The author describes a method which is specially applicable to commutator machines with the winding uniformly distributed over the stator as well as the rotor. He gives a simple fundamental equation relating to the condition of equilibrium between the tension and the different e.m.f's induced and projected on one and the same axis. This equation is then subjected to different transformations and applications are made to a study of a single-phase series motor. Since the paper is highly theoretical it cannot be intelligently dealt with in a brief abstract.—*L'Eclairage Elec.*, August 25.

Alternating-Current Commutator Motors.—Jacquin.—Continuation and conclusion of his illustrated serial on alternating-current commutator motors, with a brief mathematical discussion of the different types. The author deals with the different single-phase motors of Latour, and finally deals with single-phase motors with a stationary commutator and movable brushes, and with polyphase commutator motors and generators.—*La Revue Elec.*, June 15, 30.

Theory of Alternator.—Sumec.—Some notes on a special point of Potier's characteristic diagram of alternating-current generators.—*Elek. u. Masch.*, August 26.

Bearings.—Livingston.—A continuation of his illustrated serial on the mechanical design of electric generators. The author gives a simple graphical method for determining the size of the bearing, both diameter and length. The curves used by the author for this purpose might also be used by electrical engineers to determine the most economical length and diameter of armature to suit a given output and speed. The author refers to the fact that the method of lubrication affects the variation of the coefficient of friction considerably, and discusses methods of lubrication.—Lond. *Elec.*, August 17.

Lamps and Lighting.

Luminous Arc Lamps.—In the discussion of a paper by Preece, Crompton referred to the high luminous efficiency of the flame arc lamp. In his opinion the area which is luminous is the principal thing to look at. He had just come from the bedside of Blondell, who was at present developing a luminous arc method of illumination which promised a consumption of one-sixth watt per candle-power.—Lond. *Elec.*, August 10.

New Incandescent Lamps.—Boehm.—In the concluding installment of his serial on chemistry of new incandescent lamps, the author gives some comparative figures on the economy of different lamps. Incidentally he mentions that a tantalum lamp is not at all suitable for alternating currents, and that it is a curious fact that the latest tantalum lamps placed on the market behave even worse with alternating current than the first lamps brought out. While the first tantalum lamps had a life of some 100 hours with alternating current, it happens now that lamps burn through after 50 hours, and sometimes even after 10 hours. The reason for this curious fact has not yet been found. Of tungsten lamps the author mentions those of Just and Hanaman, Kuzel and the Welsbach Company, all of which have been dealt with in detail in Electrical World. He also states that the so-called "osmin" lamp is a tungsten lamp brought out by Osmiumlicht Unternehmung in Vienna. Osmin lamps were tested in the laboratory of the municipal central station of Munich, and 10-volt, 57.23-cp lamps consumed 1.05 watt per hefner candle. Osmin lamps tested in the Technological Museum in Vienna consumed 1.03 watt per hefner candle, and even after 1,776 hours they consumed only 1.09 watt per candle. It is intended to make osmin lamps of 40, 50 and 60 cp at 105 and 110 volts, and 80-cp lamps for 200 volts. For such lamps a filament diameter of 0.33 mm. is required. The author mentions that a ladies' hair has a diameter of 0.06 mm. For the usual voltages

around 100 volts, it will be impossible to make osmin lamps giving less than 35 or 40 cp, but this is no disadvantage since the 40-cp osmin lamp, on account of its high efficiency is equivalent to a 10-cp carbon filament lamp in power consumption. The author mentions that in daily papers lamps consuming 0.5 watt per cp are often spoken of, but he emphasizes that they are still a pious dream. "Electric incandescent lighting is still a luxurious method of lighting. With a consumption of 0.5 watt per cp electric light becomes about as cheap as gas incandescent light, at the present price of electrical energy of from 10 to 12.5 cents per kw-hour is maintained. If such lamps, however, are introduced on a large scale into practice, the consumption of electrical energy will considerably increase, which will be followed by the reduction of the price per unit of electrical energy. This would involve a development of central stations to such an extent that the present status and size of these works could be called only a small beginning."—*Chem. Zeit.*, August 4.

Incandescent Lamps.—PREECE.—A British Association paper on incandescent lamps and the grading of voltages. The author gives a concise review of the definition used in connection with incandescent lamps, their efficiency, life, standards and the effect of voltage variation and voltage regulation. He speaks briefly of the Nernst lamp and the osmium, tantalum, circonium and mercury vapor lamps. He finally discusses grading voltages and urges the adoption of vigorous standardization of incandescent lamps, the standardization of a properly legalized testing institution and consequently a measure of legal protection for the user of incandescent lamps purchased in the open market. He speaks very severely of the English manufacturer and concludes that "made in England is becoming a reproach." In the discussion S. P. Thompson questioned whether the trouble of standardizing carbon filament lamps would pay, since they are doomed anyway by the coming metallic filament lamps.—Lond. *Elec.*, August 10.

Arc Lamp Carbon Ends.—The anonymous author refers to a method, proposed by Bernard, and described sometime ago in the Digest; it consists in cementing several waste ends of arc lamp carbons together so as to form a single long carbon. For this purpose the ends of the pieces are cut off so as to fit together. They are then covered with a paste of water glass and powdered carbon, and are lightly pressed together. Such made-up carbons are likely to be very satisfactory. An English railway lighting plant has tested this method and has found it entirely satisfactory with enclosed arc lamps, but not with open arcs. The reason of the failure in the latter case is found in the excess of current at the moment of striking the open arc, as compared with enclosed arc circuit. The author points out another useful application of scrap carbon ends, namely, for lightning conductor work. Owing to the higher conductivity of carbon over that of coke, these broken pieces make an excellent bed for lightning conductors, and wherever the ground is being opened out for earth plate repairs, this fact should not be lost sight of.—Lond. *Elec. Review*, August 17.

Radiation from Gas Incandescent Mantles.—SWINBURNE.—An abstract of a British Association paper. The writer advocated the theory that the mantle radiates a great many luminous rays, because being a bad radiator it nearly attains the high temperature of the Bunsen flame. The addition to thoria of a better radiator like ceria causes a greater output, but for that reason lowers the temperature, and therefore the added ceria must be kept small. A theory opposed by Mr. Swinburne is that of "selective" radiation, which he interprets to mean that these rare earths are assumed to send out a greater proportion of energy in the form of light than do ordinary hot bodies. In the discussion Dr. Rubens claimed that a mass of experimental evidence shows once and for all that the simple high temperature theory is correct. Selective emission appears to the extent that the oxide of thorium radiates as well as a black body (but no better) at the blue end of the spectrum and not nearly so well as a black body in the infra-red.—Lond. *Elec.*, August 10.

Electric Train Lighting.—VALBREUZE.—A continuation of his illustrated series on new systems of electric train lighting. The author describes the following systems: Vickers-Hall, Dowie, Consolidated Railway Electric Light Company, Finney-MacEnroy, Bliss.—*L'Eclairage Elec.*, August 25.

Colloids.—LOTTERMOSER.—With reference to the use of colloids for making metallic filaments in the new Kuzel lamp, the author gives a concise general review on the subject of colloids.—*Jour. f. Gasbeleucht.*, August 25.

Power.

Dangers of Electricity in Mines.—FARMER.—A discussion of the dangers of ignition of fire-damp and air mixtures from sparks or arcs, which are apt to occur in electrically-operated mines. To prevent this the commutator, brushes and adjacent parts of electrical machines may be enclosed in a chamber filled with oil, this acting as a protection against access of gas, and at the same time as an insulator. Another method is to enclose the motor in a case provided with openings for the circulation of air, these openings being protected with coverings of iron wire gauze. The gauze has preferably 784 apertures per square inch, so that gas within the casing, even if it should ignite there, cannot pass its flame to the air outside. The author claims, however, that absolute safety cannot be secured with either method. It is necessary to pay constant attention to the proper maintenance of the motors, etc. All motors should be planted on good solid beds so that vibration will be reduced to a minimum. For hauling or pumping purposes the motor should never be placed on girders which are supported only at the ends. All motors should be kept clean and free from dust and superfluous oil. The dust should be constantly blown out by a pair of bellows. If electric power is used in mines poor construction should be avoided.—*Cassier's Mag.*, September.

Electric Winding Machines.—ILGNER.—The first part of a paper read before the Vienna Electric Society, giving illustrated descriptions of recent installations of electric winding machines, using the Ilgner-Siemens-Schuckert system. Some tests made in the Zollern mines are quoted, which show that the power required by the electrical system is in most cases less than one-half the power required with steam winding. Electric winding machines are also more reliable.—*Elek. u. Masch.*, August 26.

Cleaning Chimney Gases.—DAVIES AND FRYER.—An abstract from a British Association paper on the removal of dust and smoke from chimney gases. The author describes the plant at Rowntree's works. In the smoke-washing chamber in the washer are four vertical cast-iron baffles, two fixed above and two below. Water is supplied through seven spraying nozzles and also in the form of continuous sheets of falling water. The floor slopes to a water seal and is flushed automatically. In the first section of the washer, i. e., up to the first baffle, the speed of the gas is reduced and a lot of water is taken up, while heavy grit is dropped. In the next section the gases are cooled and much of the water is condensed and carries down dust and fumes. Careful observation shows that the application of steam and hot water in the first section give much better results than the application of cold water sprays at this point. The cold water is best in the second and third sections. Also, the application of sheets of water is an extravagant method; but the floors and walls must be kept wet. Usually the exit gases are about 130° F., while the waste water is about 110° F. The minimum of water to deal with 2½ million cubic feet of hot gases per hour is about 8,000 gallons, of which more than 6,000 gallons is fed to the sprays. It is found that the whole of the grit and dust, and practically the whole of the smoke and sulphur acids, are removed in the smoke washer. In the discussion Hammond remarked that the above method is excellent where water is very cheap.—Lond. *Elec.*, August 10.

Italian Water Power Plant.—Some notes on the water power plant at Zogno, which is an example of the numerous large water power stations which are being established in northern Italy. The power station contains four main generators, each driven by a 2,000-hp turbine of the Francis type, with horizontal shaft. The alternators generate three-phase currents at a pressure of 2,750 volts, 42 cycles at 350 r.p.m. The voltage is raised by transformers to 25,000 and four sets of three transformers, each of a capacity of 1,800 kilovolt-amperes are provided.—Lond. *Elec.*, August 17.

Schaffhausen.—REYVAL.—An illustrated description of the development of the hydraulic power of the Rhine from the falls near Schaffhausen.—*L'Eclairage Elec.*, August 18.

Gas Power.—Welch.—A paper read before the Natural Gas Association of America on gas engine economy. After some general remarks on gas engines, he gives some figures showing the economy of gas engines to be four or five times as large as that of steam engines.—*Prog. Age.,* September 1.

Installations, Systems and Appliances.

German Central Station.—Schirmacher.—A full illustrated description of the municipal central station of Schwerin which is interesting on account of the successful use of a modern gas plant. The station furnishes direct current to a three-wire network at 2 × 220 volts, a bare neutral wire being used. There are two suction gas producers, each for 300 to 350 hp, two single-acting, single-cylinder, two-cycle Koerting gas engines, each of 300 hp, each being directly coupled with a dynamo of 200 kw. There are also provided a 70-kw booster for charging the battery and a storage battery of 268 cells, with a capacity of 972 amp.-hours when discharged in three hours. Current is distributed throughout the city by means of underground cables. The gas plant has given perfect satisfaction.—*Elek. Zeit.,* August 23.

Wires, Wiring and Conduits.

Overhead Wires Versus Cables.—Bernard.—The author first points out some disadvantages which overhead wires have in comparison with underground cables with respect to erection and operation. He then gives a comparative estimate both of the first cost and of the cost of maintenance. The estimate is made on the basis of transmission of three-phase currents at 5,000 volts, the cross-section of the wire being 35 sq. mm. copper. He further assumes that the transmission line will last 25 years, and that it has to be amortized to the end of the 25th year. In the case of overhead transmission he assumes that ordinary poles must be replaced twice during the 25 years, while impregnated poles need to be changed only once. The author estimates that the first cost of a 1,000-meter underground cable line is 11,000 krones. The first cost of the overhead transmission with ordinary poles is 5,600 krones, and a line with impregnated poles would cost 6,100 krones. While in the first case the cable line is almost twice as expensive as the overhead line, there is almost no difference in the yearly cost of maintenance, which is about 900 to 1,000 krones.—*Elek. u. Masch.,* August 19.

Electrophysics and Magnetism.

Radioactivity.—A number of papers relating to this subject were presented at the York meeting of the British Association. Soddy spoke on "the evolution of the elements." Evolution of the radioactive type is in several features quite distinct from the old conception of the evolution of the elements. First, according to the new view, the change, though of any degree of slowness in the mass, is sudden for the individual atom. There is no gradual alteration in properties of one element's atom as it passes into another, and in this way the doctrine of the impossibility of gradual transition deduced from the nineteenth century chemistry remains unchallenged. The second distinguishing feature is that the evolution proceeds from the complex to the simple. In all previous ideas evolution implied a building up. Again, this evolution has been found to actually proceed under our eyes. Finally, the greatest differences between the old and new views is that in the new view the energy changes are the dominant phenomena and not the material changes, while in the old view the former were never considered. In the large amount of energy involved in radioactive phenomena lies the explanation of the successful resistance of the elements to all attempts to change them. Strutt read a paper on the bearing of radioactivity on the internal structure of the earth. He concludes that the radium distributed in the earth must be confined to the crust, a shell somewhat like 45 miles in thickness. Soddy read a paper on the positive charge of the alpha particles carried by radium C., a great-grandson of the radium emanation. Radium emanation shuts off positive particles and yet is not left negatively charged. This is probably due to the fact that the alpha particle steals its charge from the first atom it meets. It goes right through any atom it encounters and in this passage it acquires positive charge.—Lond. *Elec.,* August 10.

Electrochemistry and Batteries.

Denver Mint.—Whitehead and Healy.—A description of the equipment and the operating methods of the new Denver mint, the electrolytic methods of gold and silver refining being specially interesting.—*Mines and Minerals.*—September.

Units, Measurements and Instruments.

Selenium Photometer.—Haub.—A communication criticising the selenium photometer, which was recently described in the Digest, for the following reasons: Even if we may neglect the changes in the battery and the selenium cell in the course of time, yet it is impossible to neglect entirely the influence of the temperature of the selenium cell on its resistance. On account of the variation in heat produced in the cell by longer or shorter radiation and by a longer or shorter flow of the electric current, the variations of the temperature of the selenium cell may become so large that they may cause great errors in measurement. Another error due to the use of selenium will be the necessity of its reaching again the resistance in the dark. To be absolutely safe several hours would be required, while in the instrument described only a few seconds are allowed. Errors due to this effect can be easily shown by first testing with this photometer a 5-cp lamp, then a 30-cp lamp and then immediately again the 5-cp lamp. The results obtained in the two tests of the 5-cp lamp will be quite different. Finally the distance of the photometer from the lamp to be tested is considered to be too small since even if only lamps of the same construction are compared, small differences in the position of the filament may produce errors of 10 per cent or more.—*Elek. Zeit.,* August 23.

Photo-Electric Photometer.—Harms.—The Hallwachs effect, with freshly amalgamated zinc globes was used in 1892 by Elster and Geitel for photometric purposes. If the amalgamated zinc globes are replaced by layers of alkali metals in a vacuum, and if the electroscope used in the former apparatus is replaced by a galvanometer, a very simple photometer arrangement is obtained, since for the observation proper nothing is required but the reading of the telescope scale. A photometer of this kind designed by Elster and Geitel was successfully used during a recent sun's eclipse for measurements of the radiation from the sun. The author describes in detail the apparatus and gives some results obtained.—*Phys. Zeit.,* September 1.

Testing.—Fay.—The first of a serial of illustrated articles on testing large motors, generators and motor-generator sets. The present installment deals with the "loading back" of motor-generator sets.—*Elec. Journal,* August.

Telegraphy, Telephony and Signals.

Wireless Telegraphy for the Control of Submarine Boats.—Devaux.—An illustrated paper read before the International Society of Electricians in Paris and describing a submarine torpedo boat controlled by Hertzian waves by means of a single

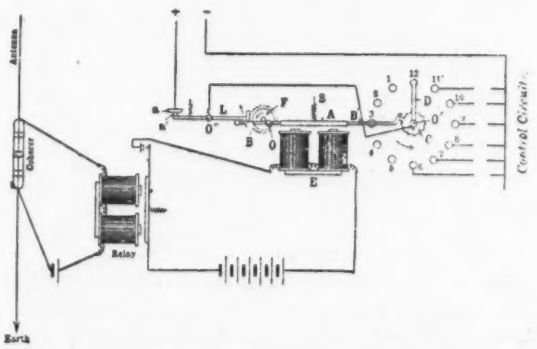


FIG. 2.—WIRELESS TELEGRAPH CONTROL SYSTEM.

coherer on board the boat, working in conjunction with a relay. Any one of twelve differently controlled circuits can be selected and energized; one corresponds to the starting of the propelling motor in forward direction, the second to starting the same motor in reverse direction, and so on. The essential organs of the apparatus are: (1) A distributor which moves over a series of contacts connected to the various control circuits, and

(2) a main control contact device which allows a current to be sent into the control circuits only when the distributor has selected the circuit which it is desired to energize. In order to accomplish this two-fold action an electromagnet is provided, through which a current is sent by means of a relay in the coherer circuit in the usual manner whenever a wave impulse is sent from the transmitting station on shore. As shown in Fig. 2, this electromagnet acts upon an armature, *A*, normally held away from it by the spring, *S*, and carried by a lever, *B B'*, pivoted at *O*. The lever arm, *B'*, carries a pawl engaging in a ratchet wheel, *C*, which carries the distributor arm, *D*, so that each time the armature is attracted the distributor arm is caused to move one step forward. The other arm, *B*, presses against and lifts the lever, *L*, pivoted at *O''*, and causes it to interrupt the main control contact, *a a'*. This lever carries at the other end a small rack engaging with teeth on a weighted wheel, *F*. The form of these teeth is such that the rack only engages with the wheel when moving in the downward direction, and the object of the arrangement is to introduce a time lag into the return motion of the lever, *L*, owing to the inertia of the weighted wheel, *F*, which has to be started into motion whenever the lever descends. This device prevents the contact, *a a'*, closing, while the rapidly succeeding impulses are carrying the distributor from point to point, and only allows it to complete the circuit when the distributor contact arm has reached its desired position and come to rest. Thus, in order to energize any particular control circuit, or to return the distributor to the "off" position, all that is necessary is to send the requisite number of wave impulses in rapid succession and then pause. In the experiments the shore station was provided with an antenna 60 meters high, composed of a group of five wires, and satisfactory results were gotten last January at distances ranging from 400 to 1,800 meters. The latter distance has been exceeded more recently with a slightly modified apparatus.—Lond. *Elec.*, August 10; from *Bull. Soc. Int. des Elec.*, June.

Multiple Telephony.—RUHMER.—A continuation of his polemics with Giltay concerning the possible use of the telegraphone for multiple telephony.—*Phys. Zeit.*, September 1.

Miscellaneous.

Presidential Address.—GRIFFITHS.—His president's address to the section of physics of the British Association for the Advancement of Science. In the first part he reviews the progress which has been made in the accurate determination of fundamental physical constants. Concerning the mechanical equivalent of heat, or as he prefers to say, "thermal equivalent of energy," he thinks we may now with some certainty say that 777.7 foot-pounds at Greenwich are very closely the equivalent of the amount of heat required to raise 1 pound of water through 1° on the hydrogen scale at 63.5° F. He then speaks at some length on the application of thermodynamics to osmotics and on technical education. He says there is a danger that sufficient attention is not paid to the foundations of physics and chemistry, and that therefore our education becomes top-heavy. While candidates frequently exhibit considerable knowledge of the most recent scientific developments, they often show a lamentable ignorance of the simple phenomena and the principles which they illustrate. As the underlying cause of the acceleration in the rate of advance of natural knowledge during the last century, the author considers the extension of our senses by mechanical applications. When we supplement our eyes by the bolometer and the electric coherer, we have a new sense for perceiving the wave lengths to which our eye is not sensitive and the range of our vision is augmented a thousand fold. By the use of the electroscope and the galvanometer, we have extended our sense of sight and touch until we can detect the presence of an electron.—Lond. *Elec.*, August 10.

Lack of Necessary Commodities.—A note referring to the gradual exhaustion of Chili saltpetre deposits, which will render the fixation of atmospheric nitrogen necessary. In his recent presidential address Hadfield states that only 10,000,000,000 tons of ore will have been required by the end of the present century.—Lond. *Elec.*, July 27.

Tungsten Lamps.

The rumored entrance of the Westinghouse Electric & Manufacturing Company into the tungsten lamp field has been confirmed, although the company itself has not given out any definite official statement on the subject. It is said that the Westinghouse interests have acquired the rights of the Osmiumlicht Unternichmung of Vienna, which has brought out the "osmin" tungsten lamp. In our Digest this week will be found a report of some remarkably satisfactory tests of this lamp as to efficiency, economy and endurance made by the Vienna Technological Museum. The Westinghouse Company has an immense new lamp factory at Watsessing, N. J., where, it is said, the new lamps will be made.

Western Electric Alternators.

Of the several large companies which are prepared to supply alternating-current generators of any capacity for any service, the latest to undertake this class of work is the Western Electric Company, the new shops of which were described in our issue for June 23, 1906. Since the alternators built by this company represent the latest developments in generator construction, it is believed that a description of these machines will prove of more than usual interest.

The alternators are of the revolving-field type. The rotor is provided with laminated pole faces. The field coils in the smaller

FIG. 1.—BOX GIRDER FRAME READY FOR CORE.

sizes are wound with square wire, and in the larger sizes with copper ribbon on edge. The edgewise-wound coil, with the bare copper exposed to the air, gives excellent ventilation and at the same time insures rigidity, compactness and freedom from shifting of conductors, which sometimes occurs when round wire is used. The stator or armature cores are built up of laminated sheet steel, in one piece in the smaller sizes and in several segments in the larger. When segments are used care is exercised to alternate the position of the joints. The discs are insulated by japanning and baking to minimize eddy-current losses and are carefully annealed after the slots have been punched to minimize hysteresis loss and to prevent "ageing." Thus the iron losses are small in value and practically constant throughout the life of the machine. The ventilating spaces provided at frequent intervals and shown in the accompanying illustrations insure uni-

form and minimum temperature of the core. By the arrangement of the coils at the end of the stator the air draft produced by the rotor is utilized for ventilation of the armature coils, as well as the core, thereby preventing excessive or injurious rise of temperature under heavy overload.

As the efficiency, temperature rise and overload capacity of any alternators are dependent upon the losses, the desire has been to so proportion the losses between copper and iron that the efficiency at partial loads and overloads is nearly as high as that at full load. By the use of multiple slots per phase per pole and

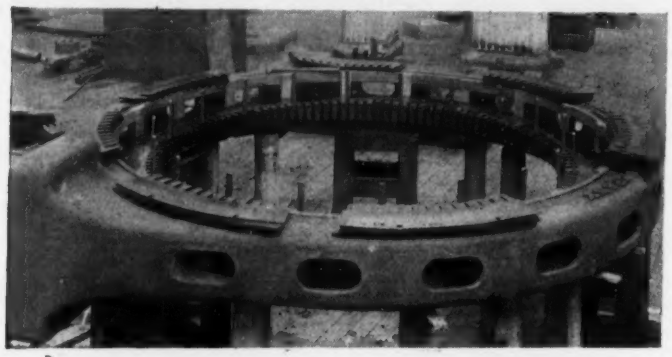


FIG. 2.—ASSEMBLING THE STATOR OR ARMATURE CORE.

by properly chamfering the poles a sinusoidal electromotive force wave has been obtained without, in any way, sacrificing the efficiency of generation.

Specially good regulation is obtained by so proportioning the parts of the machines as to reduce the two quantities which tend to cause poor regulation. The local leakage reactance of the armature circuit, and the back and cross magnetizing tendency of the armature current, are reduced to a minimum. Reactance is reduced to a minimum by the use of windings as widely distributed as possible, shallow open armature slots, and such a form of armature connection as will minimize the local leakage. The back and cross magnetization of the armature current are also reduced by this distribution of the windings and by the form of end connections. Large running clearance is used, thus improving the regulation by reason of the greater excitation required, and the consequent stiffer field.

As a result of the prevailing methods of alternator drive, there have been placed on the market three types of machines, the belted type, the water-wheel type and the engine type. The cast-

FIG. 3.—VIEW DURING WINDING OF ARMATURE.

iron armature frames are made in one piece for the belted and medium-sized machines; for the larger, engine-type, machines, they are divided horizontally, being secured at the joints by heavy eye bolts and keys or dowels. In some of the larger diameter of engine-type machines, the armature is divided into quarters, preferably at 45 degrees from the horizontal or vertical line. Special attention is given in the design of armature frames, to allow for free circulation of air in and around the armature coils and core. In the larger diameters, stiffness is insured by a deep section and large moment of inertia, so that the deflection of the frame, either from its own weight or the unbalanced magnetic pull of an eccentric armature, cannot occur.

The rotor construction on the belted and high-speed water wheel machines is entirely of laminated steel. The inner end of the pole forms a dovetail or "T" projection which is held in a corresponding slot in the laminated center by means of double tapered keys. This construction permits of easy removal of the poles for repairs. The field center is built of heavy laminations, and is homogeneous in structure, and insures uniform strength and good running balance. In the medium-speed machines of the larger sizes the field center is made of one steel casting, and the laminated poles are dovetailed and keyed in place.

Telephone Cable Terminals.

A can-top terminal that can be placed on the side or top of the pole and at the same time afford the protection offered by a long high-voltage fuse together with carbon lightning arresters has long been considered desirable, and a terminal intended to accomplish these results has been brought out by the Sterling Electric Company, of Lafayette, Ind.

This terminal has received the approval of the Board of Fire Underwriters as affording complete protection to telephone cables and in many cases, even switchboards, although the more sensitive heat coils at the inside end are relied upon to protect the latter. For the purpose for which it was intended—the cutting out of high-tension power circuits—the long tubular fuse combined with the carbon block arrester has no failures to record, being backed by heat coils of the required degree of sensitiveness.

Can-top and pole-top terminals without fuse protection have been on the market for several years, and, in sections of the country where lightning is not to be feared, still remain popular with many exchange men. The fact that these terminals can be placed anywhere at the side or top of the pole above the cross arms and out of the way of linemen who may have occasion to climb the poles makes them desirable in block and cable systems of distributions. One company alone, on the western coast, has ordered over 200 pole-top terminals within the last six months.

Ground Clamp.

A matter of special interest to central station men is the grounding of the secondary of transformers. This question is demanding more and more attention and carries with it the need for a suitable rapid and convenient attachment for grounding. The accompanying illustration shows a form of ground clamp

GROUND CLAMP.

based upon a two-piece construction having a similar metal electrical joint. The two halves are clamped together by a bolt of ample strength, and provision is made for soldering easily the No. 4 ground wire.

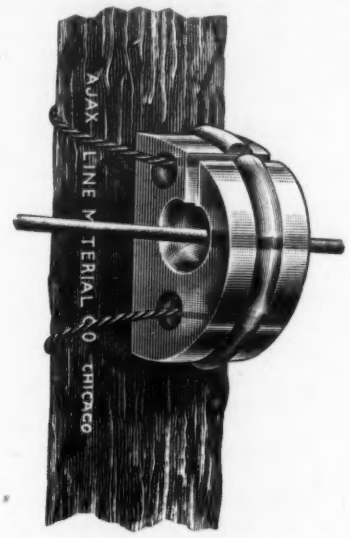
The Shawmut ground connection clamp shown is made in sizes from ½ in. to 3 in. iron pipe size, and is approved by the Underwriters' National Electrical Association. The device is made by the Chase-Shawmut Company, Newburyport, Mass.

Glass Tree-Insulator.

What is said to be the only "all glass" tree insulator is being introduced in the electric light field by the Ajax Line Material Company, of Chicago. It is the invention of Mr. Scott C. Cutter, whose test clamps are already familiar to telephone people, and

as offered for electric light circuits will take wires up to ½ in. outside diameter.

The insulator is made of a single piece of glass, toughened by annealing and provided with a slot which the wire cannot leave by accident. The cut shows it lashed to the trunk of a tree, but



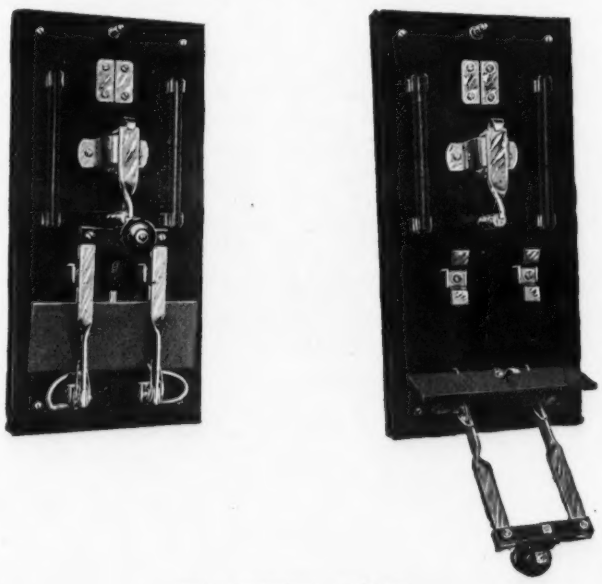
TREE INSULATOR.

does not bring out the concave ribbed back which keeps it from sliding. Naturally the ease with which this glass tree insulator can be slipped over wires already in place will readily commend it to practical men.

High Tension Safety Switch.

A switch has been placed on the market by the F. Bissell Company, of Toledo, Ohio, which is sole agent, intended to open upon a cross being made with any high-tension circuit. It will operate on five-hundredths of anampere of foreign current and is instantaneous.

If desired it can be made to operate on the appearance of a ground without the presence of a high voltage. However, this feature has some disadvantages and is practical only where a



HIGH-TENSION SWITCH.

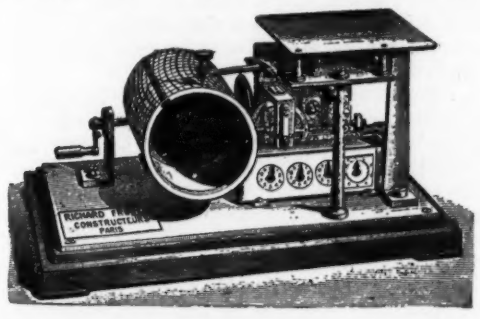
single installation is fed from one set of mains and where there is no natural ground connection.

As the switch is short-circuited across the mains there is an infinitesimal leak of current. The resistance of the carbon rods is 5,000 ohms each or 10,000 ohms total. Theoretically, this will pass .022 of an ampere on 220 volts or 4.84 watts; 24 hours × 365 days × 10 cents per kw should give $4.24 per year. In practice there is no cost whatever. On 110 volts the resistance of the carbon rods is just the same so that the cost for current figures $2.12 per year. But, as the first consumes less than one-tenth as much current as a 16-cp lamp of the best grade and the second consumes only one-twentieth as much, it is well known that no meter will turn at all on such a load. The H. & M. safety switch virtually costs the customer and the central station nothing whatever for current.

The lightning arrester feature is valuable to the central station, which owns the meter, and the switch should therefore be installed ahead of the meter. The switch is designed to protect wires when crossed with any high-tension circuit or when struck by lightning, but is not a circuit-breaker for an overload.

Positive Motion Planimeter.

The accompanying illustration shows a device for finding the area of curves having either rectilinear or curvilinear ordinates. The curve of which the area is to be ascertained is secured to a revolving cylinder, and the lines are traced by a point, guided by hand, which actuates the calculating mechanism arranged beyond the cylinders, and independent of it. The greater accuracy of this device in comparison with an ordinary planimeter resides in the fact that in the former the relative motion of the pointer and paper is definitely transmitted to the



PLANIMETER.

recording mechanism, while in the latter the total number of revolutions of the recording roll depends upon the evenness of the paper and the condition of its surface, so that the readings indicated are variable.

The positive motion planimeter is constructed by Jules Richard, of Paris, France, who is represented in the United States by Ernest H. Du Vivier, 14 Church Street, New York. The instrument is especially useful for integrating records made by recording wattmeters, dissecting load curves made by recording ammeters, or determining the mean effective pressure from steam indicator cards.

New Luminous Arc Lamp.

The Stanley-G. I. Electric Manufacturing Company has recently placed on the market a flaming arc lamp known as the Stanley-G. I. "Brilliant." These lamps are made for either alternating or direct circuits, both types being of the converging carbon construction, i. e., both carbons feed downward toward each other so as to focus the arc at the same point.

The mechanism of the direct-current lamps is of the differential magnet type, while that of the alternating lamp is of the differential disc motor type; the carbons in both cases being regulated by chain feed. Both types are designed, adjusted and carried in stock to burn two in series on 110-volt circuits—standard resistance being furnished with the direct current and a reactance coil with the alternating-current lamps. All lamps are adjusted for 12 amp., and an arc voltage of 45. Both golden yellow and white light carbons can be used on the direct-current lamps, but golden yellow only are furnished for the alternating lamps.

The weather-proof steel casings, finished in bright japan, are the same for either lamp and are interchangeable. The feeding mechanism is contained in a separate compartment of the case, so carefully partitioned off from the arc that it is unaffected by the heat or loose slag.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Excellent reports are made of trade and industry and collections are improving as fall activities become more pronounced. Jobbers and wholesalers report business active, buying free and shipments taxing facilities. Railroads return the same report as to business offering, and there are rather more evidences of strain to operating facilities by the heavy movements of crops, merchandise and fuel. Crop reports, though more variable, are in the main favorable. Corn, with late frosts, promises a record yield; spring wheat threshing, favored by good weather, points to large returns, but deterioration in the western half of the cotton belt reduces the promise of that crop, though the outlook is still for a close-to-record yield. The essential soundness of mercantile affairs is evidenced by the August failure total being the lightest in any month for several years, though individual examples of financial dishonesty swell liabilities of insolvent concerns. There were only 630 failures of individuals, firms and corporations reported to *Bradstreet's* for August, the smallest number of insolvencies in any month for seven years. The liabilities, however, owing to the inclusion of two financial institutions, were the heaviest since December, 1903, aggregating $17,200,131. There is here shown a decrease in number of 18 per cent, but an increase of 124 per cent in liabilities, as compared with August, 1905. For eight months the number of failures shows a decrease of 7.6 per cent, but the liabilities increase 3.2 per cent compared with 1905. The number of business failures during the week ending September 6 numbered 121, as compared with 138 the week previous and 137 in the corresponding week last year. Crude iron is quieter, but finished steel is in very active demand. New business in rails is of fair proportions, and the United States Steel Corporation has ordered 3,000 steel cars for its railways. Bookings in all finished lines are very good, with prospects for a marked increase in a month's time, as specifications are very heavy. Car shortages also hamper deliveries of finished goods. Bars, wire and sheets command premiums where fairly prompt shipment is demanded, but official prices have not been changed as yet. Old material has advanced at practically all markets, and the shortage of steel continues to hamper operations at the mills. The world's copper markets are absorbing copper faster than it can be produced. Five large producers of electrolytic state that they are sold out for all that can be produced during this year. Several producers of Lake are out of this year's market and are well sold through January, 1907. Casting copper was advanced on Friday to 18⅞c., thirty days. Producers quote Lake at 19 to 19¼c.; electrolytic, 18⅞c. for November and December.

STEAM TURBINE OUTPUT.—Advices from Boston report that during the year ending about the middle of April the Westinghouse Machine Company manufactured or received orders for a total of 188 steam turbines with a total capacity of 220,250 kw. During the same period the General Electric manufactured or booked orders for 323 steam turbines with an aggregate capacity of 221,175 kw. The following table shows the steam turbine expansion of each company during the year ended last April:

	General Electric.		Westinghouse Mach.	
	No.	Capacity, kw.	No.	Capacity, kw.
April, 1906	592	580,325	274	322,520
April, 1905	269	359,150	86	102,000
Increase	323	221,175	188	220,520
Average capacity—				
April, 1906		980		1,177

The average turbine of each company appears to be of about 1,000 kw capacity, the Westinghouse average being about 200 kw larger than the General Electric. This is accounted for by the fact that the General Electric is manufacturing small turbines running down to 15 kw capacity. The demand for these machines has shown a remarkable development in the past few months. The Westinghouse Machine Company manufactures few turbines under 500 kw capacity.

ACTIVITY IN COPPER continues with prices strong along the present scale of 19 cents. A leading copper selling interest says: "Not less than 10,000,000 pounds of copper, mostly electrolytic, were sold last week, this including foreign takings, the greater proportion of which will be shipped to Germany, France and England for use by the electrical manufacturers. These sales were made on the basis of 18½ cents for electrolytic and 18¾ cents for Lake. The metal situation is healthy and outlook for future market is of the best. I believe the last six months' output of copper will fall under the volume of the first half of the year. The labor question enters greatly into the situation at the moment. I do not look for an increase of more than 6 per cent over the 1905 production, the increase of the last half possibly being about 50 per cent of that of the former six months' period. Consumption for years past, on an average, has shown an annual increase of 10 per cent. This year's takings, though, will undoubtedly gain between 15 and 20 per cent. Mines of other countries are not gaining in productiveness at the same rate of American mines, hence the greatest weight falls upon the United States producers."

FEDERAL PLANT IN WASHINGTON.—J. G. White & CO. have been appointed consulting engineers to the Government for the design of the new power plant of the legislative group of buildings at Washington, D. C. The plant will supply light, heat and power to all the buildings on and adjoining the capitol grounds, and will have a capacity of 14,000 hp. It has been the purpose of the Government for some time to centralize the electric supply system of the capitol buildings in one plant, to replace the several separate plants now in service. J. G. White & Co. are retained to draw new plans and specifications, and to advise the Government engineers in selecting the design best suited for the local conditions. When these plans are completed new bids will be received by the authorities.

THE DERBY GAS COMPANY, Derby, Conn., through its engineers, W. S. Barstow & Co., has recently purchased from the General Electric Company two mercury arc rectifier sets. These sets are to be used with the present enclosed direct-current arc lamps, but are so designed that later on they can be used with magnetite arc lamps. Mr. Barstow arranged some time ago with the General Electric Company for a complete installation of mercury arc rectifiers and 1,200 magnetite lamps for the Portland General Electric Company, and these are now in operation.

COAL PLANT CONTRACT.—The Philadelphia Electric Company has awarded two contracts, one to the Mead-Morrison Manufacturing Company, for the erection of a steel skeleton tower and steel trestle, measuring 18 by 410 ft., to carry a cable railway, and another to Armstrong & Latta, for a coal pocket, 32 by 118 ft., to be erected on the east side of the Schuylkill River, south of Chestnut Street. The cost will be $36,000. These structures are for the purpose of unloading coal barges and conveying the coal into the yard of the company.

LONG WISCONSIN ROAD.—Mr. D. McAllister, ex-president of the Metropolitan Elevated, of Chicago, is head of a syndicate that has projected an interurban electric road from Chicago to Madison, Wis. H. H. Clough is associated with Mr. McAllister in the enterprise. Business men of Madison have been assured that the new line will be completed from Janesville to Madison by way of Stoughton as soon as material and labor can be secured, the financing of the Wisconsin section having been arranged for.

H. W. JOHNS-MANVILLE COMPANY.—A small fire occurred at the Brooklyn plant of the H. W. Johns-Manville Company on the evening of August 30. In spite of some exaggerated accounts which appeared in the New York newspapers, the damage was comparatively small, and the fire has not in any way interfered with the business of the company, as the department affected was in operation by noon of the following day.

MESSRS. H. M. BYLLESBY & CO. have been retained as consulting, designing and supervising engineers for the modern gas plant being built by the Indiana Steel Company (a subsidiary company of the United States Steel Corporation) at Gary, Ind., the city it is founding for the location of its new steel works.

CHICAGO TELEPHONE.—The August instrument statement of the Chicago Telephone Company shows a gain of 1,466 subscribers in the city and 675 in the country. The total number of telephones now in service is 161,120, of which 116,893 are in the city.

THE BARRIETT ELECTRIC MANUFACTURING COMPANY, of Cincinnati, Ohio, has recently equipped the Willard

Machine & Tool Company's plant with a complete equipment of Barriett motors, that concern making a change from steam power to electric motor drive.

CONEMAUGH VALLEY TROLLEYS.—The directors of the Conemaugh Valley Street Railway Company have authorized a bond issue of $1,000,000, the money to be used in building an electric line from Johnstown, Pa., to Ebensburg.

THE BENGAL TELEPHONE COMPANY is putting all its overhead wires in the Calcutta system underground. Fifty miles of cable are to be used for the work, although it is not stated that this is all that will be required.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculative uncertainty in the New York stock market, due to the rise of call money to 20 per cent, and incidental quotations as high as 40 per cent, was relieved by Secretary Shaw's offer of assistance to banks importing gold from abroad. The interrupted advances in different prominent railroad stocks were resumed, and the market showed a broadening tendency. A good effect was produced by the announcement that the Pennsylvania had sold part of its holdings of Baltimore & Ohio and Norfolk & Western, and also by various favorable annual reports of corporations, notably that of the Brooklyn Rapid Transit. On Friday the market weakened on reports of a circular to depositary banks issued by Secretary Shaw, but toward the close of the day there was a partial recovery aided by renewed weakness in the call loan market. Electric and traction stocks were irregular, some scoring substantial advances, while others declined. Allis-Chalmers common made a net gain of ⅜ point, while the preferred lost 2⅞, the closing prices being 19⅛ and 45½, respectively. General Electric is down 1½ points, the closing quotation being 167, but Westinghouse advanced 4 points, closing at the highest figure of the week—156. An active business was done in Brooklyn Rapid Transit, which closed at 81⅜, this figure representing a net gain of 4⅝ points. Metropolitan Street Railway closed at 110. American Telephone & Telegraph made a net gain of 9 points, closing at 139, and Western Union receded a fraction, the closing quotation being 91. Other stocks closed the week as follows: Central & South American Telegraph, 140; Havana Electric Railway preferred, 93, and Electric Storage Battery, 84¾. There was little change in prices on the curb market, trading being restricted throughout by the violent advance in call money to Wednesday's 40 per cent level. Following are the closing quotations of September 11:

NEW YORK

	Sept. 4	Sept. 11		Sept. 4	Sept. 11
Allis-Chalmers Co.	18¾	16¼	General Electric	166	166
Allis-Chalmers Co. pfd.	47	41⅜	Hudson River Tel.	...	...
American Dist. Tel.	25	25	Interborough Rap. Tran.	...	...
American Locomotive	71¼	71¼	Mackay Cos.	73	73¼
American Locomotive pfd.	113⅜	112¼	Mackay Cos pfd.	71	71⅝
American Tel. & Cable	88	90	Marconi Tel.	...	..
American Tel. & Tel.	130	138	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	77⅜	80¼	N. Y. & N. J. Tel.	...	...
Electric Boat	20	15	Western Union Tel.	91	91
Electric Boat pfd	60	60	Westinghouse com.	153	147
Electric Vehicle	11	12	Westinghouse pfd.	...	...
Electric Vehicle pfd.	18	18			

BOSTON

	Sept. 4	Sept. 11		Sept. 4	Sept. 11
American Tel. & Tel.	133½	138¼	Mass. Elec. Ry. pfd	...	...
Cumberland Telephone.	...	...	Mexican Telephone	...	4
Edison Elec. Illum.	239	...	New England Telephone	128	130
General Electric	169	...	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	20	...	Western Tel. & Tel. pfd.	87	...

PHILADELPHIA

	Sept. 4	Sept. 11		Sept. 4	Sept. 11
American Railways	51¼	50⅛	Phila. Electric	8⅜	8¼
Elec. Co. of America	11	11¼	Phila. Rapid Trans.	28¼	28½
Elec. Storage Battery	70	70	Phila. Traction	...	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Sept. 4	Sept. 11		Sept. 4	Sept. 11
Chicago City Ry.	160	160	National Carbon	86	85
Chicago Edison	..	143	National Carbon pfd.	119	119
Chicago Subway	54	53	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd	...	...
Metropolitan Elev.	26	27			

ALLIS-CHALMERS ANNUAL.—The Allis-Chalmers Company held its annual meeting at Jersey City last week. The meeting was confined to routine business and the election of President W. H. Whiteside to the vacancy in the directorate caused by the resignation some months ago of James Stillman. President Whiteside's report said that out of $12,000,000 of the $15,000,000 authorized issue of 5 per cent bonds offered to stockholders at 80, about which the dissatisfaction of the minority chiefly centered, subscriptions were received for only $902,000 of bonds. The underwriting syndicate which was to take those bonds unsubscribed for at 75 was allotted $9,648,000 of what was left. The balance, $1,450,000, is under option to the same syndicate. The price is not mentioned. Since the subscriptions are payable in monthly installments extending over from six to eight months, all funds resulting from the sale will not be in hand until next spring. Owing to the change in the fiscal year's termination, from April 30 to June 30, no accurate comparison can be made of the figures furnished in the report with those of last year. The deficit for 1906, however, is $388,422, an increase of $111,876 over the deficit for the fourteen months ending June 30, 1905. The report says that in the fiscal year there have been additions to the plant amounting, net, to $3,865,983, and for development of new lines of manufacture $464,708. The increase in the net current assets is placed at $2,935,006. The total increase of assets in the year was $7,356,398. The report says: "By reason of the development of new lines of machinery and the increase in our manufacturing facilities we have been enabled in the past year to secure about $4,500,000 of orders for classes of machinery not hitherto manufactured by this company, while a much larger amount might have been booked had the new works been completed within the time limits of the contracts therefor."

DIVIDENDS.—The trustees of the Massachusetts Lighting Companies have declared a regular quarterly dividend of 1¾ per cent, payable October 15. Directors of the United Traction & Electric Company have declared the regular quarterly dividend of 1¼ per cent on the capital stock of the company, payable October 1. Directors of the Westinghouse Air Brake Company have declared the regular quarterly dividends of 2½ per cent and 2½ per cent extra on the stock. In addition a special extra dividend of 2½ per cent was declared, making a total of 7½ per cent for the quarter. Directors of the Laclede Gas Light Company have declared the regular quarterly dividend of 1¼ per cent on the common stock, payable September 15. The directors of the South Side Elevated, of Chicago, have declared the regular quarterly dividend of 1 per cent, payable September 29. Directors of the Boston & Suburban Electric Company have declared the regular quarterly dividend of 75 cents per share on the preferred stock, payable October 15. Directors of the Interborough-Metropolitan Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable October 1. Directors of Providence Telephone Company have declared a quarterly dividend of $1 per share, payable October 1. A semi-annual dividend of $2.50 per share has been declared on the preferred stock of Dallas Electric Corporation, payable October 8, 1906. Directors of the Union Traction Company of Indiana have declared a dividend of 2½ per cent on the preferred stock, payable October 1. The directors of the Otis Elevator Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock.

TRI-CITY EARNINGS.—The Tri-City Railway & Light Company reports for July and for four months as follows:

	1906.	1905.	Increase.
Gross, electric	$35,422	$32,951	$2,470
Gross, railway	84,343	73,681	10,662
Gross, gas	20,531	17,850	2,680
Total gross	$140,297	$124,483	$15,813
Expenses	79,905	79,284	621
Net	$60,391	$45,199	$15,191
Interest on bonds	27,673	—	—
Surplus over fixed charges	$32,718	—	—
Dividend on preferred stock	13,000	—	—
Net profit	$19,718	—	—
Four months ending July 31:			
Gross, electric	$146,308	$137,778	$8,529
Gross, railway	290,416	259,864	30,551
Gross, gas	79,242	69,648	9,593
Total gross	$515,966	$467,292	$48,674
Expenses	327,122	299,650	27,471
Net	$188,844	$167,641	$21,202

BELL TELEPHONE PROSPERITY.—Advices from Boston state that it is believed that the American Telephone & Telegraph stock will be placed upon a straight 8 per cent basis at the next meeting of the directors, which will be held on September 19, or in December. Telephone dividends are now declared, 6 per cent regular and 1½ per cent extra per annum. Earnings are now at the rate of about 13 per cent per share per annum.

KEYSTONE TELEPHONE COMPANY.—The gross earnings of the Keystone Telephone Company, of Philadelphia, for July were $71,705 and the net earnings $31,903.

GENERAL NEWS.

Construction News.

BIRMINGHAM, ALA.—Surveys for the proposed double-track electric railway from Tuscaloosa to Gadsden by the way of Birmingham, have almost been completed, and the preliminary route located. The Tidewater Development Company is the name of the concern behind the project and franchises have been secured for entering Tusaloosa, Birmingham and Gadsden. J. M. Dewberry, of this city, is at the head of the project.

MONTGOMERY, ALA.—A certificate of amendment to the consolidation agreement of the Electric Lighting Company, of Mobile, and the Mobile Electric Company, has been filed with the Secretary of State, in which was set forth the intention of the company to issue $150,000 more of the preferred stock, which will make a total of half a million dollars. The capital stock of the company is $3,000,000. Under the original consolidation agreement, $2,650,000 of the stock was common. By the amendment, this stock has been reduced to $2,500,000. The majority of the stock of the company is owned by James S. Cummins of Chicago.

FRESNO, CAL.—Jas. T. Boyd, of San Francisco, is planning the erection of a steam power plant in Fresno in competition with the San Joaquin Light & Power Company.

ANAHEIM, CAL.—An ordinance has been passed granting to the Engineering and Construction Company a franchise to construct and maintain a telephone and telegraph system in Anaheim.

SAN DIEGO, CAL.—Ulysses S. Grant, of San Diego, and a large number of other California and Oregon capitalists, have presented to the Board of Aldermen an ordinance for submission to the people, asking for a franchise for an automatic telephone system to be installed in this city.

MENDOCINO, CAL.—The Union Lumber Company expects soon to erect a new and greatly enlarged electric lighting plant near the mill.

SANTA BARBARA, CAL.—The Merchants' Mutual Light and Power Company will issue bonds for the sum of $75,000, to provide means for improvements.

UKIAK, CAL.—It has been decided to resume work on the power plant on Eel River as soon as materials can be obtained. The plant is owned by the Snow Mountain Power Company, of which Senator Felton, W. W. Van Arsdale, U. S. Surveyor General Graham and W. P. Thomas are stockholders.

FRESNO, CAL.—The Fresno Traction Company is planning to spend $200,000 for the following improvements: Double tracking Sunnyside system to the Recreation Park; erection of a steel and concrete car barn; construction of the company's part of the Fresno St. subway. A. G. Wishon has been ordered to secure material at once.

VALLEJO, CAL.—It is reported that another railway is to have Vallejo as a terminus. The surveyors for the new road have just completed the preliminary survey through the Green Valley section of this country, situated a few miles north of Vallejo. This road is to be built from Sacramento to Vallejo, and active work will be commenced at once.

SELMA, CAL.—Electricity is now being transmitted for 60 miles at 40,000 volts from Crane Valley to this place, where the San Joaquin Light and Power Company has a substation for reducing the e.m.f. to 4,000 volts for general distribution. 20,000 hp is obtained from the waters of the San Joaquin River. The company is now preparing to supply a rapidly increasing demand for electric service in this place.

FRESNO, CAL.—G. O. Newman, chief engineer for the power interests of H. E. Huntington, states that he has 17 electric plants in hand and has already completed eight. There will be seven constructed in the San Joaquin Valley, of which three will be on Tule River, one at Doyle's, one at the forks and one near the club house, and the others will be in Southern California. A million-dollar steam plant for generating electricity has just been completed at San Pedro, also a substation at Fresno, with 1,600 hp.

SAN BERNARDINO, CAL.—One of the largest water projects planned for this season was made public recently by the filing on 1,200,000 miners' inches of storm and flood water in the east and west forks of the Mojave River, ten miles southwest from Hesperia. The filings were made by B. A. Lieser, acting for the Arrowhead Reservoir and Power Company, at the request of R. L. Dalby, employed by the Arrowhead people. The filings indicate two large reservoir schemes on the north side of the mountain watershed, to impound storm water.

SAN FRANCISCO, CAL.—The question of using electric power for operating trains on the Southern Pacific Railroad over the Sierra Nevada Mountain Division has been broached again, and rumor has it that Westinghouse interests are making a thorough investigation of the problem. The Southern Pacific is planning the construction of some tunnels on the Mountain Division so as to eliminate the heavy grades, but whether the matter of electric traction is under serious consideration is problematical. The report is spread periodically that electric traction is to be used by the Southern Pacific, but no outward evidence of such work is yet evident.

REDWOOD CITY, CAL.—The Peninsular Electric Railroad Company plans to begin construction work as soon as it obtains right-of-way from a few remaining property owners. The company's large shipments of rails are beginning to arrive and are being unloaded at San Carlos. The engineers have completed their final survey and have announced that the course taken through San Mateo County is from the southeast corner of the University Park, through East Greenwood, to a point near the Redwood City depot, and then parallel to the Southern Pacific track to San Mateo. The company has submitted to the trustees of Stanford University an application for a right-of-way across the campus from the county road to University Park. The Stanford station will be located at the stone gateway at the extremity of Lasnen row.

FRESNO, CAL.—Chief Engineer G. O. Newman will have charge of the surveys and construction work at the Wishon power plant of the San Joaquin Power Company. Two substations have been completed and are connected with the main power line. One is four miles west of Selma and this will supply Selma, Kingsburg, Fowler and the Caruthers country. The other substation is in the 76 country, and will supply Dinuba, Reedley, Sultana, Crosi, the Great Western Winery and the Mount Campbell orange district. Part of the pole line has been built from the substation to Kings River, and part from the river to Dinuba. Work is now being done on the city distribution in Selma, Dinuba, Kingburg, Reedley and Fowler. The temporary plant will have a capacity of 150 hp, and all of the power will be utilized in the above work and furnishing lights for the camp and tunnels.

PASADENA, CAL.—Bids will be received until Sept. 25 by Wm. Waterhouse, Mayor, and the City Council at the office of Herman Dyer, city clerk, for materials and equipment as follows, to be used in the construction of a generating station for a municipal electric lighting plant. Bids to include all or a portion of the apparatus, completely erected on foundations furnished by the city, horizontal or vertical cross compound condensing slow-speed release gear, operating at 100 r.p.m. or medium speed, four-valve Corliss steam engines, operating at from 150 to 200 r.p.m. steam turbines or internal combustion engines or from 225 to 300 hp capacity at standard ratings; water-tube boilers of wrought steel construction, a suitable stack to be included in the boiler bids; fuel economizer; duplex boiler feed pump; a closed type feed-water heater; 164, 200 and 300-kw, 3-phase, 60-cycle, 2,300-volt, revolving-field alternating-current dynamos; switchboard, etc. The probable cost of the plant complete is $125,000. Wm. Reeves is city electrician and S. F. Pearson, city engineer.

DURANGO, COL.—S. W. Henderson, general manager Standard Light & Power Company, writes that bids will probably be received some time this fall for the new work contemplated by this company, which will cost about $350,000. H. T. Henderson, Durango, is chief engineer.

MIDDLETOWN, CONN.—The Consolidated Railroad Company is asking for bids for a trolley line from Middletown to Meriden.

MIDDLETOWN, CONN.—At a meeting of the Common Council, Sept. 5, the city was authorized by resolution to establish and manage an electric lighting plant and also to sell electricity to corporations and individuals. The resolution must be approved by the mayor for two successive years, and then be ratified by the voters.

NEW BRITAIN, CONN.—The New York, New Haven & Hartford Railroad Company is arranging to install an additional machine of 2,500-hp in its electric plant at Berlin. The present capacity of the plant is 2,000 horse-power. Power for the operation of the Meriden trolley system is now transmitted from Berlin. It is understood that the enlargement of the power capacity is in anticipation of the equipment of several steam tracks in this locality with an overhead trolley.

WILMINGTON, DEL.—The affairs of the new Commercial Light, Heat and Power Company, which recently secured a light franchise from the city, are progressing rapidly and the plans of the company will be completed in a few days.

WILMINGTON, DEL.—There is a proposition on foot to establish an electric railway between this city and Chesapeake Haven, on the Chesapeake Bay, a trip of about one hour and twenty minutes. The Interurban Railway Company has obtained a charter for the purpose of operating such a line from Fifth and King Streets, in this city. It is proposed to turn Chesapeake Haven into a summer resort, and with this end in view the Chesapeake Land Improvement Company has been organized.

WASHINGTON, D. C.—J. G. White & Company, of New York, N. Y., have been appointed consulting engineers by the U. S. Government to design the new power plant of the Congressional group of buildings at Washington. The group includes the Capitol, the new House and Senate buildings and the Congressional Library.

WASHINGTON, D. C.—Wireless communication will be established with the Island of Tutuila by the navy within a few months if the recommendations of the officers in charge of the work are approved by the higher officials. This is the only important naval sation where a wireless plant has not been erected, and the navy deems it of importance to have arrangements by which the commandant may communicate with ships which are sailing the South Seas and perhaps with distant land stations.

WASHINGTON, D. C.—Bids will be received until October 2 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the Navy Yards at Mare Island, Cal., and Puget Sound,

Wash., a quantity of naval supplies as follows: Schedule 134—Insulators, bar iron, sewer pipe and fittings, cast and wrought iron pipe, pipe fittings, steam traps, etc. Schedule 136—Conductor, electrical supplies, hydraulic jacks, cedar, Oregon pine, etc. Schedule 137—Electrical wire and supplies, cedar, bar steel, iron pipe, pipe fittings, valves, etc. Applications for proposals, should designate the schedule desired by number. H. T. B. Harris, Paymaster-General, U. S. N.

ALBANY, GA.—Joseph P. Roman, of Atlanta, representing Western capitalists, has petitioned the City Council for a franchise for an electric railway. Mr. Roman agrees to have the car line in operation within nine months after the franchise has been granted.

ATLANTA, GA.—A charter has been granted to the Atlanta & Carolina Railway, the proposed route of which will extend from this city to Anderson, S. C., and west of Atlanta to the Alabama line, a total distance of 170 miles. It is proposed to operate the entire system with electricity.

WASHINGTON, GA.—The stockholders of the Anthony Shoals Power Company, who own that piece of property on Broad River in the northern part of Wilkes County, known as Anthony Shoals, have ratified the recent action of the board of directors, increasing the capital of this company to $5,000,000. J. H. and T. M. Fitzpatrick, of Washington, are the majority stockholders in the concern which promises to develop this unutilized water power. It is the intention to transmit electricity from Broad River to Washington, Augusta and Elberton to be used for commercial purposes. Contracts have already been made with several mills in Augusta, Ga., for the sale of one-third of the power.

COTTONWOOD, IDAHO.—A. A. Alvord, village clerk, writes that it is proposed to construct an electric light plant, to cost about $12,000. Fred Erskine, of Cottonwood, is the engineer for the enterprise.

YORKVILLE, ILL.—A project is on foot for the construction of an electric railway from here to Lisbon Center, Plattville, Newark and Helmae and on the Serena, through Glen Park.

METAMORA, ILL.—Mayor Irving and other leading citizens have interested themselves in the formation of a company for the construction of either a gas or electric lighting plant for the city.

LAFAYETTE, IND.—This city is considering the installation of a new telephone system.

HUNTINGTON, IND.—Work will soon begin on the construction of the Indianapolis, Huntington, Columbia City & Northwestern Traction line.

SOUTH BEND, IND.—The Home Telephone Company has decided to lay about a mile of underground conduits. Theo. Thorward is president and manager.

TERRE HAUTE, IND.—The Indianapolis & Western Interurban Company intends to build a line from Harmony to Terre Haute to parallel the Terre Haute Traction and Light Company's line.

VINCENNES, IND.—Surveys have all been completed for the Vincennes, Baden & Louisville Railway, to extend between Vincennes, Monroe City, Petersburg, Otwell and Jasper. There will be some 41 miles of single track. Geo. A. Thompson, Vincennes, is chief engineer of the company.

SOUTH BEND, IND.—It is reported that Vice-President J. M. Caulfield, of the Kalamazoo & South Bend Traction Company, has bought a right-of-way from this city to Constantine and thence north to Florence. Work on the roadbed will begin this fall and within one year it is the purpose to have the road in operation.

TERRE HAUTE, IND.—The Vigo County Commissioners have granted a franchise to the Terre Haute Traction and Light Company, to construct, maintain and operate transmission lines on any highway east of the Wabash River and north of the National Road until such lines are connected with the present right of way along the National Road.

SOUTH BEND, IND.—Charles A. Chapin and associates have secured a franchise to construct and operate a million dollar dam and plant in the St. Joseph River about 12 miles north of this city, for the purpose of generating electricity for South Bend and surrounding communities. The backwater will make a fine lake or reservoir one mile wide and seven miles long.

PERU, IND.—The Home Telephone Company is in the market for a new switchboard in order to accommodate the increasing business. The company has installed 180 country lines and has 50 more lines ready to be put into service as soon as a new board can be installed. The company has recently completed a direct line to Rochester and branch lines to Macy and Santa Fe.

DUBUQUE, IA.—A Minneapolis-Chicago electric line via Dubuque is being planned.

WELECTKA, I. T.—George Mittendorf has secured a franchise to construct an electric light and power plant.

WEATHERFORD, I. T.—The Weatherford Interurban Railway & Light Company, organized to operate interurban electric lines in four directions, proposes to install all electric light plants along the line of railway at various points.

BOONE, IA.—The Fort Dodge, Des Moines & Southern Railway will be extended to Lake Okoboji.

MUSCATINE, IA.—It is reported that the Childs-Hudswit Company has secured control of the properties of the Citizens Railway and Light Company, of Muscatine, Ia.

FAIRFIELD, IA.—An election will be held Sept. 5th, to vote a tax of 3 per cent to aid the Iowa-Missouri Traction Company in constructing an interurban railway between this city and Keosauqua.

WEBSTER CITY, IA.—The City Council has passed a franchise giving the Boone Webster City Interurban Railroad Company the privilege of operating in this city. An exemption from taxation for five years was also granted. A depot site and a right of way will be donated.

MANHATTAN, KAN.—An electric lighting and steam heating plant will be installed at the State Home for the Orphans and Aged.

WOLCOTT, KAN.—Fire destroyed the power house of the Kansas City-Leavenworth Electric Railway, causing a loss of about $200,000.

OTTAWA, KAN.—Jack Nelson has ordered an electric elevator for his new business block here. The building will have its own system of lights and electrical power.

TOPEKA, KAN.—The State Board of Control has awarded the contract for installing a telephone system at the Parsons insane asylum to the E. M. Reed Electrical Company of Kansas City.

SEDAN, KAN.—Through their local representative, C. D. Inglefield, John H. Heckman & Co., of Coffeyville, Kan., have asked for a franchise here to put in an electric lighting system for the town.

TOPEKA, KAN.—The State charter board has granted a charter to the Southwestern Interurban Railway Co., having a capital of $20,000, for the purpose of constructing interurban lines between Arkansas City and Parsons and Coffeyville.

LOUISVILLE, KY.—The Kentucky Electric Company, of which Donald McDonald is preident, has made the final payment of $90,150 for the electric lighting franchise, and will rush forward the work of laying conduits, etc.

DE RIDDER, LA.—D. O. Dunn is interested in the construction of water works and an electric light plant.

OLD TOWN, ME.—The electric light building at Kidder's Point, Stockton, is nearly completed and the lights will be ready this month.

AUGUSTA, ME.—The Belfast Illuminating Company is making extensive repairs and improvements and enlarging the capacity of its plant.

PORTLAND, ME.—The contract for installing the heating, lighting and power plant in the new county courthouse has been awarded to the Buerkel Company of Boston for $59,997.50.

AUGUSTA, ME.—Fred W. Bolster, of Milo, has been awarded the contract to build the new power station for the Milo Electric Light & Power Company on the site formerly occupied by Pierce's saw mill.

WATERVILLE, ME.—The bid of the Union Gas & Electric Company for street lighting, was $3,995 per year for the lamps now in use, and $35 per annum for each additional arc lamp and $10 for each additional incandescent. The Mesalonskee Electric Company has submitted a bid at $36 per arc lamp per year and $4 per year for each incandescent lamp. The contract has not yet been closed.

HAYATTSVILLE, MD.—The Potomac Electric Power Company, of Washington, has submitted a proposition to light the streets by means of electricity. The company agrees to install not less than 100 30-cp incandescent lamps at the rate of $12 each per year, and arc lamps at the rate of $65 each per year.

WESTBORO, MASS.—The Westboro Gas & Electric Company has been awarded the contract for the complete wiring of the new public library.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company will change its lighting system to magnetite arc lamps, with mercury arc rectifiers, and will also install incandescent lamps of 40 cp.

LOWELL, MASS.—The mayor has under consideration the lighting of Princeton and Pawtucketville Boulevards by electricity. According to the recent lighting contract the mayor has power to install sixty-six additional lamps.

GARDNER, MASS.—Small industries and factories of Gardner are taking advantage of the small rates made by the Gardner Electric Light Company and are installing electric motors in their plants instead of steam and gasolene. P. H. Loughlin has sold a 20-hp motor to the L. G. McKnight Company, a 15-hp motor to Collier & Keyworth, and a 10-hp motor to W. H. Shaughnessy.

LAWRENCE, MASS.—Work on the new power house of the American Woolen Co., at Lawrence, Mass., has already been started. The building is to be of unusual strength and a retaining wall of great thickness will be built on the Union Street side, the foundation for which will be 40 feet deep, the depth of the buttresses of the bridge. Here will be located the engines and dynamos which will supply the power for the Washington mills plant, and for the new section of the Wood mill, the foundation for which is rapidly approaching completion.

TEMPLETON, MASS.—Rylmer Smith, chairman of the electric light commissioners, states that they had decided to let the contract for the municipal electric light plant for the town of Templeton to F. E. Ley & Co., Springfield, who were the lowest bidders. The work will be started as soon as the material can be procured. The plant for the present will consist of poles and wires, the current will be supplied by the Gardner Electric Light Co., Gardner, for four cents per kilowatt. To light the four villages of the town of Templeton, including Templeton, East Templeton, Otter River and Baldwinville about eight miles of wire will have to be strung.

PORT HURON, MICH.—The excavating for the new tunnel power house on Military Street has begun. The entire foundation will be of concrete.

STURGIS, MICH.—A proposition has been made by Mr. H. Almert in behalf of the Constantine Hydraulic Co., wherein a joint franchise was asked for 30 years for a gas and electric light service.

STURGIS, MICH.—Burr Oak village council has granted an electric lighting franchise to Edgar Seaver, of that village, and has contracted for electric street lamps. The plant will be operated by both water and steam power.

BRONSON, MICH.—The new electric light plant to replace the one recently destroyed by fire is nearly completed. The structure is 52x64 feet, two stories high and constructed of cement blocks. The roof will be of slate and the whole building will be practically fireproof.

EAST GRAND FORKS, MINN.—Bids are wanted Sept. 24 for furnishing the city with electric light.

FAIRMONT, MINN.—The citizens have voted to issue bonds for improvements to the water and light plant.

ST. PETER, MINN.—The Cannon Valley Telephone Company will make improvements to its system to cost $20,000.

BIG FALLS, MINN.—The Northwestern Telephone Company, owner of the local exchange, will extend its present line northward from Blackduck to Big Falls, in the near future.

KELLIHER, MINN.—Engineer M. D. Stoner, of Bemidji, Minn., writes that bids are wanted until Sept. 17 for the construction of water works and an electric light plant at a probable cost of $10,000. J. W. Murray is the village recorder.

FERGUS FALLS, MINN.—A deal has been closed here according to which the Great Western Telephone Company, which owns the exchanges at Wahpeton, Milnor, Lisbon, Hankinson, Forman and Fairmount, N. D., and at Breckenridge and Campbell, Minn., together with intermediate and branch toll lines, sells its entire system to the Northwestern Telephone Company. The controlling interest in the Great Western was held by Fergus Falls men.

ST. CLOUD, MINN.—The Northwestern Telephone Exchange Company continues to spend money in St. Cloud in betterments. The conduits have been laid for eight or ten blocks in the business section of the city, being of four and six ducts, and the wire crew will soon commence the laying of the wires and cables underground. Many of the overhead cables will be taken down and in the business part of the city only the long-distance copper wires will be overhead. So far as possible the individual telephone wires from the underground cables will be strung through the alleys. Two hundred new poles will be set throughout the city and betterments in very direction are being made. The local office has just received direct from the Western Electric Company a new four position central battery switchboard, consisting of two sections and having a capacity of 400. This will give 800 lines and with the present growth of the business it will not be long before all are in service.

JACKSON, MISS.—Manager Prout, of the Jackson Street Railway Company, announces that work on the double-track on State Street will begin immediately.

ST. LOUIS, MO.—The Kinloch Independent Telephone Company, of St. Louis, has taken formal possession of the Wabash Valley Telephone Company of Paris, Marshall and Chrisman, Ill., adding to its lines some 5,000 telephones.

ST. LOUIS, MO.—The Board of Public Improvements, Sept. 7, considered the lighting of the streets. To obtain the data suggested by President O'Reilly a committee of three was appointed. This committee will investigate and report on the cost of a municipal plant. It was the general opinion of the members that the district lighted by electricity should be extended. This would include parts of Grand, Vandeventer, Taylor, Easton and Lafayette Avenues.

ST. LOUIS, MO.—Mr. Thomas B. Carter, as supervisor of city lighting, has submitted a statement to the board of public improvements, showing the present annual cost of lighting the streets to be $548,939.23. This embraces 637.01 miles of streets and 18,235 lamps of all kinds. The business district is included in the report. Four years ago the municipal assembly passed an ordinance authorizing the setting aside of $140,000 annually for the ultimate purchase of a municipal lighting plant. City Controller Player has not set the money aside. He gives as his reason that if this had been done various institutions of the city would have had to suffer. Mr. Player has declared that he is not opposed to municipal ownership of a lighting plant if civil service rules are to apply. He suggested several weeks ago submitting the question to the people as to whether a bond issue should be authorized for the purpose. He estimates that $1,000,000 would be sufficient to establish a municipal lighting plant. These figures do not coincide with those of an electrical expert, connected with the city administration. This expert declares that $1,500,000 would be necessary for a plant of sufficient capacity to light the city.

AUBURN, NEB.—The Auburn Electric Light & Power Company is considering the extension of its system to Johnson and Brock.

FREMONT, NEB.—It is proposed to remodel the electric light plant and water works, but nothing definite has yet been done. L. D. Richard is secretary of the Board of Water and Light Commissioners.

BERLIN, N. H.—As already noted a new company has been formed composed of Berlin and Portland men under the name of the Berlin-Shelburne Power Company. Its incorporators are E. A. Noyes and Edward Woodman, of Portland; Edmund Sullivan, O. B. Brown and J. P. Dubey, of Berlin. It is understood that this company takes over the business of the Berlin Electric Light Company, and will assume the plant which is now being built in Shelburne. The capital is $50,000, which may be increased.

BELVIDERE, N. J.—A project is on foot by capitalists of Albany, N. Y., to tap the Delaware River at a point near Smith's Hotel on the Pennsylvania side, a short distance above, and direct the water for electrical purposes, carrying it in a canal a distance of three or four miles to the foot of Big Foul rift, at which point a power-house will be constructed.

CAMDEN, N. J.—The Street Committee of Camden City Council, after a year's delay, has decided to accept the proposition of the Bell Telephone Company to place its wires underground. The company has agreed to give its poles to the city for the projected municipal lighting plant and to place the wires of the city's fire and police system in the conduits. It is stated that when the conduit system is completed the rates for telephone service will be reduced by from 20 to 30 per cent.

CHENANGO FORKS, N. Y.—Peters Bros. have decided to construct a dam and power house on Chenango River at this place.

BUFFALO, N. Y.—Ground has been broken for the new trolley line along the lake shore that will give Buffalo a trolley service with Erie, Pa.

COHOES, N. Y.—The Hudson River Electric Power Company, of Glens Falls, has purchased property here, and will erect a transformer station to cost about $50,000.

CHARLOTTE, N. Y.—The village board is contemplating raising between $15,000 and $20,000 to provide for improvements in its water system and electric lighting plant.

LOCKPORT, N. Y.—The City Council has accepted the proposition of the Lockport Gas & Electric Light Company, to furnish electric street lamps at $55 per lamp per year.

OSWEGO, N. Y.—It is announced that the Oswego River Power Transmission Company has about completed its work of getting options on a right of way from Baldwinsville to Oswego. The company expects to deal in electrical energy obtained from Niagara Falls.

NEW YORK, N. Y.—Bids will be received until Sept. 17 by C. B. J. Snyder, Superintendent School Buildings, New York City, for installing the electric equipment in the addition to and alterations in School 134, Borough of the Bronx; also in new School 21, Borough of Richmond.

JAMAICA, N. Y.—Eleven miles of ducts are being laid in this place by the New York and New Jersey Telephone Company for the purpose of bringing all the trunk lines in the new five-story central building on Hardenbrook Avenue, a short distance north of Fulton Street. There are from four to twenty ducts in each trench.

WADDINGTON, N. Y.—The New York & Ontario Power Company has petitioned the New York State Gas Commission at Albany for permission to begin business with a capital of $2,000,000 stock, and $2,000,000 bonds. It proposes supplying Waddington, Lisbon and Ogdensburg with electricity for light, heat and power; supply the paper mills and transmit power across St. Lawrence River to Canada, and to the Canada Tin Plate & Sheet Steel Company, of Morrisburg, Ont.

ROCHESTER, N. Y.—City Engineer Fisher has recommended that the bid of the Rochester Railway and Light Company, for the street lighting contract, be accepted. The bid calls for 500 arc lamps connected with the underground circuit, located singly, at $68 each per year; 500 arc lamps connected with the underground circuit, located in pairs, at $62.96 each per year; 2,600 arc lamps connected with overhead wires, at $78.50 each per year, and 200 32-cp incandescent lamps at $19.34 each per year, the total annual cost being $220,018.

SYRACUSE, N. Y.—The State Commission of Gas and Electricity has announced its decision, granting the application for an order fixing the maximum price of gas in Syracuse at 95 cents per 1,000 cubic feet, beginning Oct. 1. The price of electricity for street lighting is fixed at $68 per lamp, for commercial purposes at 9 cents per kilowatt hour for one year beginning Oct. 1, the price after that to be 8 cents. Present lighting rates in Syracuse are: Arc street lamps, $85.77½ per lamp per year; commercial incandescent, 12 cents per kilowatt, with 2 cents discount if paid before the 15th of month; gas, $1 per 1,000 maximum.

LITTLE FALLS, N. Y.—The following are the bids opened on Sept. 4 by the City Council for lighting the streets for a period of five years, beginning January 1, 1907: Hudson River Electric Co., arc lighting, alternating current, 5-year period, $34 per lamp per year, with 5-year extension privilege, $33; 10-year period, $32.50 per lamp per year, 25-cp incandescents, 5-year period, $12 per lamp per year, 10-year, $11.50; for arc lighting, direct current, magnetite lamps, 5-year period, $37.50 per lamp per year with 5-year extension, $36.50, or 10-year period, $35. Herkimer County Light & Power Co., arc lighting, alternating current, 5 years, $35, and incandescents, 25 cp, 5 years, $12.

ONEIDA, N. Y.—An attempt to have made permanent the Madison County Gas & Electric Company's injunction, restraining Mayor John H. Richardson, of Oneida, from entering into a contract with the Empire State Power Company for lighting the streets and public places of the City of Oneida for a term of five years from January 1, 1907, has been made before Justice Lyon in Binghamton. On the part of the city and the Empire State Company an effort will be made to have the injunction set aside that the city may proceed with the execution of the contract as per the recent award of the Board of Public Works, which, pursuant to the terms of the city charter, awarded the contract to the Empire State Company, the bid of that company on both the two and five-year propositions being the lowest of the five submitted.

STATEN ISLAND, N. Y.—The contract between the city and the Richmond Light and Railroad Company for the lighting of Staten Island has been signed by Controller Metz. It dates from March, 1906, to March, 1907, and involves about $100,000. The controller held up the contract because he considered that the company had not furnished adequate service. The company declared that it was doing the best it could with the plant it had. It promised, however, to give better service to

the citiens by cutting of some off the current furnished to the Staten Island beach resorts. There is no other electric power company on Staten Island. Acting Mayor McGowan has inspected the plant of the Edison Company in East 38th Street with Engineer Lacombe of the Department of Gas, Electricity and Water Supply. He made the inspection with a view to recommending improvements to the Staten Island Company, based on the New York Edison system.

ASHEVILLE, N. C.—As soon as the signatures of the city authorities are secured, work will be started on the underground system of the Bell Telephone Company. The lead conduits have been received and the work will be rushed.

SALISBURY, N. C.—The recent floods on the Yadkin River have wrought damages to the amount of $10,000 to the Whitney Power Company, at Whitney, where the noted Narrows are being harnessed by the Whitney Company, of Pittsburg, Pa.

ROANOKE, N. C.—The Rosemary Manufacturing Company, of Roanoke Rapids, N. C., has awarded the contract for wiring and poles for their 600-kw turbine generator to the Chesapeake Construction Company of Norfolk, Va. Plans and specifications are by Fred S. Hines, of Boston.

NORTH WILKESBORO, N. C.—On account of recent freshets in western North Carolina, much damage has been done and the electric plants have not escaped. At North Wilkesboro, a town of about 7,000 inhabitants, a newly raised dam on Reddies River was washed away and the electric lighting facilities thereby so crippled that the town is in darkness.

ASHEVILLE, N. C.—The offer of $30,500 for the Sulphur Springs tract of 388 acres recently made by Prof. Otto B. Schenfield, of New Orleans, to the Asheville Electric Company, has been accepted. This tract is located about five miles from Asheville, and it is expected that an electric trolley will be constructed from this place to the Sulphur Springs section.

STATESVILLE, N. C.—The Southern Power Company has finally submitted to the town of Statesville, N. C., a proposition to bring electric power to that place if $16,000 is guaranteed the first year, $20,000 the second year, and $24,000 the third year. There is plenty of desire on the part of the town to secure the power, and a satisfactory outcome is believed to be in sight.

MINOT, N. D.—The Minot Light & Telephone Company is extending its telephone system and making improvements.

WILLISTON, N. D.—Contracts for construction of the power and pumping system of the Williston project, have been awarded as follows: To the D'Olier Engineering Company, Philadelphia, Pa., boiler plant and steam operated pumps, Station 1, and transformers and electrically operated pumps, Station 2, and transformers and electrically operated pumps, Station 3, and to the General Electric Company, of Schenectady, N. Y., for electric generating plant. The bids submitted for the transmission line for building for Station 1 were rejected. It has not yet been decided whether to do the work by force account or to procure new bids. A. P. Davis is acting chief engineer, U. S. Reclamation Service, Washington, D. C.

DEFIANCE, O.—Surveyors have started out over the proposed line from here to Montpelier.

HAMILTON, OHIO.—The citizens voted Sept. 1 to issue $65,000 to improve the electric light plant.

LOGAN, OHIO.—The Board of Public Affairs is considering the question of constructing an electric light plant.

MARIETTA, OHIO.—The Marietta Telephone Co. will soon begin on a $50,000 expenditure on the proposed improvements.

ROCHESTER, OHIO.—Articles of incorporation have been filed for the Merchants Mutual Telephone Company, with a capital stock of $1,000, by Alexander Rudd and others.

TOLEDO, O.—Negotiations have been in progress for some time by the Toledo, Port Clinton & Lakeside Electric Company to gain an independent entrance into the city by way of Starr Avenue.

ROCKY RIVER, OHIO.—The Rocky River Electric Light Company will soon be incorporated for the purpose of supplying electricity to the village of Rocky River. The company is preparing to build a plant.

MT. VERNON, OHIO.—H. W. Hisey, of Zanesville, has purchased the plants of the Mt. Vernon Electric Light Company, the Mt. Vernon Electric Street Railway and Lake Hiawatha Park, and will make improvements.

MOOREFIELD, OHIO.—The Farmers' Mutual Telephone Company, of Moorefield, has been formed by Clarence Cotten, Scott Danner, John W. Riley and others. They will build a mutual system centering at Moorefield.

HAMILTON, OHIO.—The voters of Hamilton voted by a majority of 10 last week to issue $350,000 of bonds for the purpose of rebuilding the municipal water, gas and electric light plants and to pay off the indebtedness of the city.

TOLEDO, OHIO.—The application of the Toledo, Port Clinton & Lakeside Electric line for an independent entrance to Toledo is now in the hands of a special sub-committee of the City Council, composed of Messrs. Staunton, Ulmer and Bingham.

COLUMBUS, OHIO.—Dr. S. B. Hartman will file a written application for a franchise for the construction of a trolley line from his farm south of Columbus to the end of the present line of the Columbus Railway and Light Company, in South High Street.

DAYTON, OHIO.—The Dayton Street Railway Company's system will be entirely reconstructed the fall and winter months. The system has been changed from steam to hydro-electric; the electricity for operating the plant is purchased from the Condor Light & Power Company. F. H. Farrar is superintendent.

LAKEWOOD, OHIO.—The electors of Lakewood will vote October 16th to decide whether to sell the village lighting plant, which has become inadequate for the needs of the village, or to issue bonds for $25,000 to increase the capacity of the plant. A resolution providing for the election has been passed by the council.

CINCINNATI, OHIO.—John W. Hill & Sons, of this city, state that the proposed work contemplated by the Little Miami Light, Heat & Power Company, consists of 14 dams and water power stations with auxiliary steam plant. The probable total cost of work is $1,500,000. Louis J. Dolle and others, of Cincinnati, are interested.

CINCINNATI, OHIO.—Receivers of the Miami & Erie Canal Transportation Co. are negotiating for the sale of the equipment of some of the substations which are stored in various places and are useless for the present operation of the business. It will be remembered that the company undertook to operate canal boats by electricity and the venture failed financially.

TOLEDO, OHIO.—A. K. Detwiler, of this city, who has been granted a franchise to build an independent telephone plant in San Francisco, has been in Toledo arranging for the purchase of equipment. A switchboard with an initial capacity of 15,000 telephones will be installed and the plant will have an ultimate capacity of 80,000 telephones. It will require about two years to complete the work.

DAYTON, OHIO.—The Dayton Citizens Electric Company has purchased a plot of ground 160 ft. x 300 ft. on E. Third St., on which will be erected a large power station for the company's new electric light system.

BELLEVILLE, OHIO.—The Belleville Electric Light & Power Company's plant was totally destroyed by fire last week. The plant was owned by Alias K. Gardner and there was no insurance.

CLEVELAND, OHIO.—A. S. White, of New York, and H. S. Moore, of Cincinnati, who recently undertook the merger of the Cleveland gas companies, are now negotiating for the merger of these companies with the East Ohio Gas Company, which controls the natural gas situation in Cleveland with the Cleveland Electric Illuminating Company, which controls the bulk of the electric illuminating business in Cleveland.

CINCINNATI, OHIO.—The Little Miami Light, Heat & Power Company, recently formed by Louis J. Bolle and John W. Hill, the latter a prominent engineer, with a view of erecting a water power plant in the Little Miami River, has succeeded in securing the riparian rights for nearly 10 miles of water front along the river. The work of building the dams and erecting a power station will be started in the near future.

CLEVELAND, OHIO.—The new east exchange of the Bell Telephone Company, now being erected, will cost $50,000, and it will be ready for service shortly. It will contain two switchboards of the latest type with an ultimate capacity of 9,600 lines each, built by the Western Electric Co., and costing $125,000. The new building will provide comfort for the employes in every way. A rest room, kitchen and dining-room in charge of a matron is provided for the operators.

CLEVELAND, OHIO.—United States Telephone Company has made an arrangement with the National Telephone Company, of Wheeling, by which a new long-distance line is to be built from Wheeling to Cambridge, Ohio, which will give West Virginia towns direct connection with all parts of Ohio over independent lines. United States Telephone Company is stringing additional circuits between Columbus and Springfield, Columbus and Cleveland, from Cleveland to Akron and Canton and from Toledo southward through Findlay, Lima and Dayton. Important improvements are said to be under consideration for some of the local plants owned by the Cleveland company.

CLEVELAND, OHIO.—The Lorain Railway Company has been chartered with a capital stock of $2,000,000 by Edward W. Moore, Fred W. Coen, G. C. Ford, D. F. Williams and C. B. Easty. The company is a consolidation of the Lorain Street Railway Company and the Avon Beach & Southern Railway Company. The new company has an authorized bond issue of $2,000,000, of which $750,000 goes to retire the bonds of the Lorain Street Railway, $500,000 to pay for the Avon Beach & Southern and to make needed improvements, and $750,000 to remain in the treasury for future needs. The improvements which are now under way include the double tracking of the entire line between Lorain and Elyria and the building of a new loop in Lorain.

CLEO, OKLA.—The Cleo Telephone Company, having a capital of $5,000, has been incorporated by C. R. Williams and others.

NEW CASTLE, PA.—It is stated that a new electric light plant will be put in operation in this city, backed by James Mooney and other capitalists.

PECKVILLE, PA.—The borough plant is installing new capacity to the extent of an engine and dynamo of 260 horse-power, new boilers, switchboard, etc.

ALTOONA, PA.—The Citizen Electric, Heat and Power Company, at Ninth Avenue and 20th Street, has started extensive improvements, including the installment of new machinery, which, when completed, will double the capacity of the plant.

PITTSBURG, PA.—The Pittsburg, Harmony, Butler and New Castle Railway Company, of which R. H. Boggs is the president, has let the contracts for the construction of the road, which will cost almost $3,000,000, and cars will be in operation between Pittsburg and Butler and Pittsburg and New Castle, by July 1, 1907.

WASHINGTON, PA.—Conspicuous among the stacks which rise from the factories on the south side of the Baltimore & Ohio Railroad, is

the new 125-foot chimney for the plant of the Washington Electric Light & Power Company. The stack is a splendid example of brick structural work, and was put up by the Custodis Chimney Constructing Company, of New York. The interior part is 7½ feet in diameter at the top and widens to 18 feet at the base, which is of concrete. Radial blocks were used in the construction. The boilers have just been installed and a 400-foot coal tipple will be built.

MIDDLEBURGH, PA.—The stockholders of the Middlecreek Electric Company held a meeting at the offices of the company in Sunbury, last Thursday, and adopted by-laws, and elected Thos. H. Hutchinson and Adolph Oppenheimer, of Sunbury, additional directors. At a meeting of the board of directors, F. P. Llewellyn asked to be relieved of the duties of the treasurership, on account of being treasurer of so many different concerns, and as he preferred to see the position go to Sunbury. Mr. Llewellyn's resignation was accepted and T. H. Hutchinson was elected. Mr. Llewellyn continues as a director of the company.

SALT LAKE CITY, UTAH.—A new and enlarged power plant will be erected in the rear of the Emery Holmes apartment house, to supply electricity to lamps and motors in the new addition which will be built next spring.

MILWAUKEE, WIS.—Fire destroyed the Phœnix International Light Company's plant in this city, causing a loss of $22,000.

ST. CLAIR, WIS.—The Peninsular Electric Light Company, now controlled by the Detroit Edison interests, has formed a new company for the extension of the business of furnishing electricity for lamps and motors through the counties of Macomb and St. Clair.

PORT WASHINGTON, WIS.—Bids will be received until Sept. 17 for a 100-hp suction gas producer and engine, a 500 gal. triplex power pump and a 700 gal. high lift centrifugal pump. Specifications and bidding sheets can be obtained from W. G. Kirchoffer, C. E., Madison.

New Industrial Companies.

THE NEW YORK ELECTRICAL TRADES' SCHOOL, New York, N. Y., has been incorporated with M. A. McDonald and J. L. O'Connor as directors. The capital stock is $3,000.

THE CITY TELEPHONE CONSTRUCTION COMPANY has been formed at Chicago, with a capital stock of $10,000, to make and sell electrical appliances. The incorporators are John G. Lizars, S. N. Cotterman and John T. Fisher.

GENERAL TELEPHONE EQUIPMENT COMPANY has been formed at Chicago, with a capital stock of $5,000, to carry on a manufacturing and merchandising business. The incorporators are Edgar F. Seney, A. W. Levy and Frank J. Noonan.

THE LANGSTADT-MAYER CONSTRUCTION & SUPPLY COMPANY, Appleton, Wis., has been incorporated with a capital of $50,000 for the purpose of doing electrical and mechanical engineering, building electric light plants and both steam and water power plants. The general offices of the company are to be located at this place.

New Incorporations.

CENTER, TEX.—The Center Electric Light Company has been incorporated by S. T. Fleshman and others.

PLAINVIEW, TEX.—Articles of incorporation have been filed for the Central Plains Telephone Company, with a capital of $10,000, by L. Lee Dye and others.

HOUSTON, TEX.—Articles of incorporation have been filed for the Southern Telegraph & Telephone Company, with a capital stock of $100,000. The directors are George W. Burkitt and others.

PASCO, WASH.—Articles of incorporation have been filed for the Twin City Telephone Company, with a capital stock of $20,000, by R. A. Klinge and others.

ROCKFORD, WASH.—The Spokane County Electric Company has been incorporated with a capital of $10,000. H. W. Collins, of Rockford, is one of the incorporators.

SPOKANE, WASH.—The Entiat Telephone & Telegraph Company has been incorporated by Frank E. Knapp, D. M. Faris and P. M. Martin, all of Entiat, with a capital stock of $10,000 to do business in the Big Bend country and adjacent territory.

PROSSER, WASH.—The Hanford Irrigation & Power Company has been incorporated, with a capital of $250,000, to construct a power and irrigation plant at Priest Rapids, between Kennewick and Prosser. J. W. Young, of Seattle, is one of the incorporators.

LAWTON, W. VA.—The Laurel Creek Electric Company has been incorporated, with a capital of $100,000.

ST. ALBANS, W. VA.—The St. Albans Water & Light Company has been incorporated by V. E. Mohler, George C. Weiner and others.

PARDEEVILLE, WIS.—The Fox River Milling and Power Company, capital $50,000, has been incorporated by J. R. Shattuck and others.

LOYAL, WIS.—The Loyal Telephone Exchange Company has been incorporated at Loyal, Clark County, Wis., by C. M. Taylor, M. M. Weaver and H. Haslett, with a capital stock of $1,500.

GREEN BAY, WIS.—Articles of incorporation have been filed for the Bay Shore Telephone Company, with a capital stock of $10,000. The incorporators are Henry F. Hagemeister, Frank J. B. Duchaben and C. A. Straubel.

RHINELANDER, WIS.—The White River Power Company has been incorporated with a capital of $300,000 by A. W. Sheldon, E. A. Edmonds, C. A. Wixson and others, to construct a dam at White River, about 6 miles south of Ashland, and develop power for electrical purposes.

VANCOUVER, B. C.—The Independent Light & Water Company has filed articles of incorporation with a capital stock of $50,000. The incorporators are A. Welch and others.

TORONTO, ONT.—The Dominion District Steam Heating Company has been organized here to manufacture gas, electricity, etc. The directors are W. Seccombe, G. E. Bradshaw, H. L. Dunn, all of Toronto.

TORONTO, ONT.—The Para Docks, Ltd., have been incorporated with a capital of $17,500,000 to manufacture electricity for various purposes, also to build docks, wharfs, etc. J. S. Lovell is one of the directors.

FORT WILLIAM, ONT.—The Northern Engineering & Supply Company has been incorporated with a capital of $100,000 to manufacture electricity for light, heat and power purposes. The directors are: W. J. Ross, J. T. Horne, J. M. Patton, Fort William, Ont.

MONTREAL, QUE.—The Magdalen Islands Development Company has been incorporated with a capital of $2,000,000 to manufacture gas, electricity, etc. The directors are: C. E. Archibald, J. N. Pyke and S. A. Finley, Montreal.

Company Elections.

OKLAHOMA CITY, OKLA.—The reorganization of the Oklahoma City, Lexington and Sulphur Springs Electric Railway Company has been effected, and Col. E. P. Spears, of Dallas, Tex., has been appointed president and general manager.

NEWBURG, N. Y.—The Orange County Traction Company has been reorganized as a result of the sale of the property by the Pouch interests and ex-Gov. Odell and his associates. Former Mayor B. B. Odell, Sr., father of the ex-governor, has been elected director to succeed William H. Pouch, who has been general manager of the company. Postmaster Hiram B. Odell, brother of the ex-Governor, has been elected to succeed E. D. Pouch, of Brooklyn; W. Johnston McKay to succeed Silas B. Dutcher of Brooklyn; Herbert R. Odell to succeed James B. Kilsheimer, of Manhattan; B. B. Odell, Jr., to succeed F. H. Pouch, of Brooklyn, and Cornelius L. Waring to succeed W. H. Hacey (president), of Montclair, N. J. Other directors whose resignations were accepted, but the vacancies left unfilled for the time being, were J. H. Coon, of Brooklyn, and A. B. Pouch (secretary), of Tompkinsville, S. I. The only member of the board of directors remaining is W. H. Burroughs, of Brooklyn. Following the change in the directorate a meeting of the new board was held, at which the following were elected as officers of the Orange Traction Company: President, Benjamin B. Odell, Jr.; secretary, W. Johnston McKay; treasurer, Hiram B. Odell.

Obituary.

MR. C. M. BALL.—Mr. Clinton M. Ball, 62 years old, of Hill street, Rockaway, N. J., died at his home on September 10. He was an inventor and a mechanical and electrical engineer. He was a native of Hoosick Falls, N. Y. He leaves a widow, two sons, and two daughters.

MR. C. W. PHIPPS.—With deep regret we record the death of Mr. Charles Walter Phipps, who for the past five years has been works manager at Rugby, England, for the British Thomson-Houston Company. He had been ill for some time past, but his friends did not regard his ailments seriously, especially as he was only 47 years of age. Mr. Phipps was a native of Worcester, England, but he came to America early in life, and was closely identified with the electrical industry, doing a great deal of pioneer work. He travelled all over the world in the interests of the Brush Electric Company, of Cleveland, and was particularly concerned with the installation of arc lighting apparatus, some of the first plants in the United Kingdom, and also in Japan, being laid down under his direction. When the Brush Company lost its identity, Mr. Phipps became associated with the Adams-Bagnall Company, of Cleveland, and then was invited to join the forces of the General Electric Company. Mr. Phipps remained with the General Electric Company until he was appointed to the post at Rugby, which he filled with such credit to himself and satisfaction to the corporation. He leaves a widow and one son of 14 to mourn his loss, as well as a host of friends on both sides of the water, who admired him as the best type of Anglo-American.

Personal.

MR. ALFRED MAJOR, former president of the American Bridge Company, has been elected a director of the Keystone Telephone Company, of Philadelphia.

MR. ALEX. DOW, well known as vice-president of the Detroit Edison system, the Peninsular Electric Light Company, etc., has been elected president of the Association of Edison Illuminating Companies.

DR. S. KIMURA, professor in the Imperial Japanese Navy, has arrived in this country en route to Berlin, Germany, where he will attend the wireless telegraph conference.

MR. SAMEUL C. SHAFFNER, formerly engineer and general manager of the Illuminating Company of Mobile, Ala., has joined the engineering staff of H. M. Byllesby & Co., Chicago.

MR. HORACE E. SHURTLEFF is in poor health and has resigned as inspector of street lights for the city of Brockton, Mass., and electrician of the police department, to take effect October 1.

MR. W. MARCONI is booked to sail to-day with his wife from Liverpool on the "Caronia." It will be remembered that he was attacked with serious grippe, etc., when intending to sail last spring.

MR. R. C. HUNT, formerly manager and engineer of the San Diego Consolidated Gas & Electric Company, has joined the engineering staff of H. M. Byllesby & Co., and will be located at their Chicago office.

MR. EARL McDONALD has accepted a position with the Shasta Power Company, and will proceed to Redding, Cal., where he expects to be engaged during the next year in the construction of a large hydro-electric plant.

MR. GEORGE F. MADDOCK, formerly general superintendent of A. L. Ide & Sons, Springfield, Ill., and for some time past practising consulting engineer with offices in Marquette Building, Chicago, has joined the engineering staff of H. M. Byllesby & Co., Chicago.

MR. O. A. FARRAR, formerly engineer of Allis-Chalmers Company, has joined the engineering staff of H. M. Byllesby & Co., and has charge of the reconstruction work of the large modern electric lighting plant which H. M. Byllesby & Co. are constructing at Mobile, Ala.

MR. F. H. REED, one of the inspectors of the Fire Prevention Bureau of New Orleans, has just been appointed city electrician for Shreveport, La., and will also be in charge of a branch of the Bureau there, making inspections in the northern part of the State.

MR. D. H. BATES, the veteran telegrapher and financier is to contribute to the *Century Magazine* an article on "Lincoln in the Telegraph Office." During the war, as a young operator, Mr. Bates was very close to Mr. Lincoln and enjoyed his confidence.

MR. MARTIN LOEWING, who was formerly connected with the New York Edison Company, and with the New York City Department of Water, Gas & Electricity, is now with the Fire Prevention Bureau of New Orleans, which is doing much to improve the standard of electrical work in that city.

MR. DAVID PEPPER, JR.—The firm of Pepper & Bowie, consulting and contracting engineers, with offices in the Land Title Building, Philadelphia, has been dissolved owing to the death of Mr. John R. Bowie, and the business will be carried on by Mr. David Pepper, Jr., under his own name at the old address.

MR. WILLIAM ALBERT HALL, formerly president of the Hall Electric Company of Cincinnati, O., has been engaged by the Allis-Chalmers Company to assist Mr. Colwell in the sales department at Cincinnati. Mr. Hall has a large number of friends and acquaintances in the electrical field, all of whom wish him well in his new position.

MR. GEORGE CALDWELL, formerly with Christensen Engineering Company, and later with the Allis-Chalmers Company, has recently started a general machinery brokerage business in the Andrus Building, Minneapolis, Minn. Mr. Caldwell's long experience and wide acquaintance in the machinery field, especially in the Northwest, ought to make him a valuable representative of machinery builders in the East.

MR. W. H. BRODIE has been appointed manager of sales of the Edison Manufacturing Company, of Orange, N. J. He has been connected with the company for the past six years in the manufacturing department, and is therefore thoroughly familiar with the Edison battery, etc. He succeeds Mr. W. S. Logue, who died last April. Mr. Brodie intends to make the personal acquaintance of the trade and industry.

MR. GEO. B. GORDON, who for more than two years has been prominently connected with the plant department of the Chesapeake & Potomac Telephone Company, of Washington, assisting in the installation of the common battery system, has resigned from the company to return to the service of the New York Telephone Company. Before leaving Washington Mr. Gordon was presented by his associates in the Chesapeake & Potomac Company with a handsome umbrella as a slight token of their appreciation.

MR. HOWARD E. TROUTMAN, for over ten years connected with the Buckeye Engine Company, and for several years manager of its Chicago office, has resigned to accept the sales management, Corliss and high-speed engine department of the Atlas Engine Works, Indianapolis. Mr. Troutman's headquarters will be at the home office. Mr. J. M. Broucher, of the Brownell Company, Dayton, Ohio, has resigned his connection with that company to accept the position of assistant general managership of sales for the Atlas Works.

MR. P. W. SOTHMAN, consulting engineer of New York, has been chosen by the Ontario Hydro-electric Commission as chief engineer of the electrical staff of the commission, and under the general direction of Commissioner Cecil B. Smith. He will be specially charged with constructing, estimating and supervising for the various municipalities which apply to the commission for electric power under the act. Mr. Sothman is admirably qualified for the position. He was born in Denmark in 1870 and graduated from the Institute of Technology at Charlottenberg, Germany. For seven years he was an engineer for the Siemens & Halske Electrical Company in developing water powers in Germany, Russia and South Africa.

NORMAN McD. CRAWFORD, formerly general manager of the Hartford Street Railway Company, of Hartford, Conn., and a resident of that city for fifteen years, has accepted the office of vice-president of the Indiana, Columbus & Eastern Traction Company, the Lima & Toledo Traction Company and the Cincinnati Northern Traction Company. Mr. Crawford has a wide reputation as an electrical engineer. He has only recently returned from England, where he spent six months investigating electric street railways for the National Civic Federation. In Hartford his services in building up the local company are well known. As a contractor there in 1891 he put in the first section of the Glastonbury line and remained as engineer. In 1894 he was made general manager of the company, and remained in that position until the Consolidated Railway Company, acting for the New York, New Haven & Hartford Railroad, took control last year.

MR. FRANCIS E. DRAKE, who has just been appointed general manager of the Societe Anonyme Westinghouse of Paris, and Le Havre, has had an interesting career. Besides his earlier experience in the services of the Flint & Pere Marquette Railway, as telegraph operator, he had been five years sales manager of the Standard Electric Company of Chicago, and nearly two years manager of the Walker Electric Company, Cleveland, when the United States Government appointed him director of machinery and electricity at the Paris Exposition (1900) for the purpose of organizing what was threatening shortly to become an embarrassing situation for American exhibitors. When Mr. Drake came on the scene he found that, with careful pruning, and making a liberal allowance for withdrawals, the bona fide intending exhibitors required more than three times the space at his disposal. Few who remember the American electrical and machinery section of that year and its unique annex, housed apart in a beautiful building at Vincennes, are aware that Mr. Drake was responsible not only for the idea of a separate building but also for its complete design, construction and lay-out. The idea was an immense success and gave great satisfaction to the American Government as well as to exhibitors, and resulted in his being decorated by the French Government. In 1901, Mr. Drake was appointed to reorganize the works of the Union Electricitäts Gesellschaft of Berlin, which he carried through and finished in 1903. The following two years found him again in America as president of the Lanyon Zinc Company, one of the largest zinc smelting firms in the world. In April, 1905, Mr. Drake returned to Europe to organize the continental business of the Chicago Pneumatic Tool Company, and founded in Berlin the Internationale Pressluft und Elekitricitäts Gesellschaft, m.b.H., of which concern he is general director. Mr. Drake is also a director of the Consolidated Pneumatic Tool Co., Ltd., of London, and a member of the Engineers' Club and the Lawyers' Club of New York. His American friends, who are legion, note with interest and pleasure this new and important association of his with one of the largest electrical enterprises on the Continent.

Trade Publications.

CONDULETS.—A price-list and catalogue of C.-H. condulets has been issued by the Central Electric Company, 264 Fifth Avenue, Chicago, Ill. It is stated that condulets are to the electrical wireman what ells, tees and other fittings are to the plumber or steam fitter.

GREGORY ELECTRIC COMPANY, Lincoln Street, Chicago, has issued a very curious "barometer"—a paper donkey whose flexible tail by its motions and positions gives a very close prognostication of the weather. It can be had on request, and no home or office is complete without it.

SMALL POLYPHASE MOTORS.—Bulletin No. 4448 of the General Electric Company, Schenectady, N. Y., gives an illustrated description of small polyphase induction motors in which each machine has been rendered extremely compact by omitting the old style cast iron shell over the stator laminations, and clamping the lamination between cast iron rings, the complete core being directly exposed to the air. These machines are built in sizes from .75 to 7.5 hp.

METALLIC PACKING.—The C. Lee Cook Manufacuring Company, Louisville, Ky., has issued an illustrated catalogue devoted to Cook's metallic packing for steam, gas and air. This packing is intended for power engines of every description, and is especially adapted to extra heavy duty service on reversing bloom mill engines, blowing engines, rolling mill engines, marine engines, locomtives and engines operating under very high steam pressure and superheat. The catalogue contains a long list of users, classified according to the services to which the packings were put.

News of the Trade.

CONDUIT RODS.—Mr. T. J. Cope, of Philadelphia, the manufacturer of the well-known Cope quick coupling conduit rod, has recently secured a contract from the U. S. Government to install his patent cable racks at the League Island Navy Yard, Philadelphia; and has successfully carried out the work.

THE CENTRAL ELECTRIC COMPANY, of Chicago, enjoys the distinction of having a room fitted up and devoted exclusively to the display of fixtures. It is located on the first floor of its new building at 264-270 Fifth Avenue, in connection with its retail department and all the latest styles and finishes of electric and combination fixtures are to be found therein. No more complete line of portables and table lamps is shown anywhere, and anyone interested is cordially invited to visit the Central Electric Company when in Chicago.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 4, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N.Y.]

829,968. RAILWAY SIGNAL AND SAFETY APPLIANCE; Charles J. Kintner, New York, N. Y. App. filed June 6, 1904. A complete system for train control having special contact plates bolted to the roadbed ties to contact with the wheel flanges for setting the signals. A feature of the invention lies in an arm projecting above the roof of each car which is directly engaged by the semaphore arm at danger and constitutes a train stop.

829,969. SAFETY APPLIANCE FOR RAILWAYS; Charles J. Kintner, New York, N. Y. App. filed Jan. 27, 1905. Additional features of the above, and particularly with reference to the operating means of the semaphore signals which have continuous current motors, and stop motion cut-outs for their actuation.

829,974. ELECTRICALLY OPERATED MINE DOOR ACTUATING MECHANISM; John C. Lincoln, Cleveland, O. App. filed Apr. 10, 1903. The mine door has operating mechanism therefor which is set in motion by a circuit established by the passage of a train over a single insulated rail section.

829,975. VARIABLE-SPEED ELECTRIC MOTOR; John C. Lincoln, Cleveland, O. App. filed June 27, 1905.

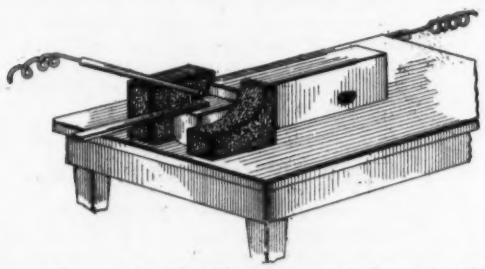
830,025. DYNAMO-ELECTRIC MACHINE AND THE LIKE; Ludwig Torda, Barking, England. App. filed June 2, 1905.

830,030. PROCESS FOR THE MANUFACTURE OF COMPOSITE TOOLS; Henry V. Wille, Philadelphia, Pa. App. filed Nov. 15, 1905. A slender bar of chrome steel alloy is impelled against a shank of ordinary steel, the bars being connected to opposite potential sources, so that the alloy steel is melted and fused to the shank to make a lathe tool.

830,051. APPARATUS FOR THE ELECTROLYTIC EXTRACTION OF METALS; Courtland F. Carrier, Jr., Elmira, N. Y. App. filed Jan. 30, 1905.

830,093. APPARATUS FOR GALVANIZING WIRE; Guy L. Meaker, Evanston, Ill. App. filed June 18, 1902.

830,119. CONTROL OF APPARATUS GOVERNING THE PASSAGE OF CARS OR VEHICLES ALONG A RAILWAY; Herbert A. Wallace, New York, N. Y. App. filed June 13, 1906. Relates particularly to the circuits for operating a train stop in installations having the usual direct current energized track rails divided into block sections.



830,030.—Process for the Manufacture of Composite Tools.

830,131. ELECTRIC RAILWAY SYSTEM; William M. Brown, Johnstown, Pa. App. filed Apr. 27, 1905. The third rail is sectionally energized by switches along the roadway which are drawn into circuit closing relation during the passage of a train by a magnet carried thereby. The magnetic circuit is completed through the collector shoe and the third rail.

830,158. SYSTEM OF MOTOR CONTROL; Axel Magnuson, New York, N. Y. App. filed July 6, 1905. Has three sources of current supply, one of which is led to the motor, another of which is generated by the movement of the motor, and the third of which is in a battery and is derived from said second source of supply, said three sources of supply adapted to control the motor.

830,161. TELEPHONE; John Z. Miller, Erie, Pa. App. filed Oct. 30, 1902.

830,164. ELECTRICALLY OPERATED LINE INDICATOR FOR RAILWAYS; Claud D. McPhee, Arnprior, Canada. App. filed Oct. 2, 1905. Provides a plurality of stations having a telephonic communicating system, the current of which is superimposed on the telegraph wire and a plurality of signaling devices thrown into operation when the telephonic current passes through them.

830,208. CRUCIBLE; Edward A. Colby, Newark, N. J. App. filed Nov. 23, 1906.

830,209. AUTOMATIC TRANSFORMER CUT-OUT; DeWitt C. Conkling, Hoboken, and John E. Winn, Weehawken, N. J. App. filed Nov. 14, 1904. Provides a relay in the secondary circuit of the transformer which closes a special circuit whenever the load is entirely removed. This second circuit positively actuates the primary cut-out. Has a battery for energizing the relay to again cut the transformer into circuit.

830,224. INCUBATOR; George L. Guyer and Arthur C. Gamble, Wessington, S. D. App. filed Dec. 30, 1905. When the incubator lamp goes out, a vane descends to close an alarm circuit.

830,242. SYSTEM OF MOTOR CONTROL; Axel Magnuson, New York, N. Y. App. filed Sept. 20, 1905. Complete arrangement of circuits whereby an elevator motor may be started, stopped and otherwise controlled from a controller having only two positions of throw.

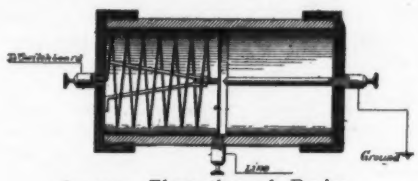
830,247. SELECTIVE SIGNAL SYSTEM FOR RAILWAYS; Frank R. McBerty, Evanston, Ill. App. filed July 24, 1905. Complete plans for a signal system having danger and caution signals and a test circuit containing two points of control, one closed in setting the semaphore and the other by the movement of a selector arm at the operating station.

830,249. SEAL AND TERMINAL FOR ELECTRIC APPARATUS; Henry N. Potter, New Rochelle, N. Y. App. filed Jan. 11, 1904. A method for sealing the electrodes into quartz vacuum tubes so as to make a hermetical joint notwithstanding temperature variations. Has a seal made of metallic silicon wire.

830,253. TELEGRAPH KEY; Jesse T. Sheets, Covington, Ky. App. filed Nov. 9, 1905. The button at the end of the key is swiveled and has a pin to engage the usual circuit opening switch and keep it in open relation while the key is being actuated. The switch automatically returns to circuit closing relation when the key is released.

830,254. FIRE PROTECTION SIGNAL SYSTEM; John E. Shepherd, Chicago, Ill. App. filed Apr. 25, 1904. Provides a fire alarm system in conjunction with a fire extinguisher adapted to cause the transmission of signals to a supervising station upon the occurrence of various troubles in the fire system.

830,262. CONTINUOUS CURRENT ELECTRIC MOTOR AND GENERATOR; Ludwig Torda, Barking, Eng. App. filed May 6, 1905. In order to vary the speed of small direct-current motors the patentee has a gap in the magnetic circuit in which an iron wedge is adjustable to various relations.



830,391.—Electrothermal Device.

830,271. TELEPHONE SYSTEM; David H. Wilson, Chicago, Ill. App. filed Jan. 2, 1906.

830,272. TELEPHONE APPARATUS; David H. Wilson, Chicago, Ill. App. filed Jan. 2, 1906.

830,279. TELEPHONE-TRANSMITTER; Henry F. Albright, New York, N. Y. App. filed Oct. 21, 1904.

830,299. METHOD OF PRODUCING AMMONIA AND CAUSTIC ALKALI; Gunnar E. Cassel, Stockholm, Sweden. App. filed Aug. 22, 1904.

830,306. ELECTRIC LIGHT AND POWER CONTROLLER; Fredrich C. Damm, St. Louis, Mo. App. filed Sept. 18, 1905. A laterally swinging arm on the chair leg engages a push button on the floor so as to control the motor of a sewing machine by the weight of the operator.

830,316. JUNCTION BOX; Edwin T. Greenfield, Monticello, N. Y. App. filed Oct. 10, 1904. Details of a yoke clamp for securing the cables within an outlet box.

830,317. JUNCTION BOX; Edwin T. Greenfield, Monticello, N. Y. App. filed Oct. 28, 1904. Additional features of an outlet box employing a form of clamp which is adjustable into alignment with the holes of the box.

830,347. ELECTRIC MOTOR; David Mendelson, New York, N. Y. App. filed Nov. 8, 1905. A special construction of motors of that class having a revolving member with radially projecting electromagnets, the polarity of which is reversed in passing fixed electromagnets in a stationary frame.

830,391. ELECTROTHERMAL DEVICE; Charles E. White, Chicago, Ill. App. filed June 22, 1903. A pair of air chambers are separated by a flexible diaphragm connected to a circuit closing device and the circuit to be protected has a heat coil in one of the chambers so that the diaphragm is moved and the circuit opened by excessive current therein.

830,409. TROLLEY; Herschel L. Bryant, Tonkawa, O. T. App. filed Oct. 31, 1905. A pair of plates are hinged to the harp and have a lever connection with the bearings of the trolley wheel by means of which the plates are impelled upward whenever the trolley wheel has a tendency to leave the wire.

830,419. FIELD-COIL INSULATION AND PROCESS OF FORMING SAME. Louis W. Downes, Providence, R. I. App. filed Oct. 22, 1904.

830,441. INSULATING MEANS AND METHOD OF MANUFACTURING THE SAME; George Kelly, Hinsdale, Ill. App. filed Oct. 30, 1905.

830,457. ELECTRIC BRAKE; Frank L. Sessions, Columbus, O. App. filed Jan. 17, 1905. In order to avoid excessive speed in elevators, etc., the patentee has a brake which is thrown into action by a differentially wound magnet, one coil of which is in the armature circuit of the motor. When the motor runs as a generator this coil assists the other to apply the brake.

830,472. CONTROLLER FOR AUTOMATIC RAILWAYS; Benjamin F. Carpenter, Roselle Park, N. J. App. filed May 12, 1904. In order to avoid the disturbance in small automatic electric carriers by two cars following one another too closely to be properly switched into different branch lines, the patentee has a special device by which the rear car is specially switched to follow the first one in such a case.

830,473. ELECTRICALLY WOUND CLOCK; Percy L. Clark, Bristol, Conn. App. filed Oct. 13, 1902. After the spring has unwound to a certain extent, a chamber containing mercury is inverted into such a relation that a circuit to start the rewinding motor is automatically closed.

830,475.—Potential Indicating Device.

830,475. POTENTIAL INDICATING DEVICE; George N. Eastman, Chicago, Ill. App. filed May 5, 1904. A sealed glass chamber contains a metallic rod and a piece of gold leaf suspended adjacent thereto whereby the potential of neighboring objects is indicated electrostatically.

830,477. INCANDESCENT LAMP; James W. Forster, Chicago, Ill. App. filed March 24, 1905. In place of having the filament free in the lamp, the patentee wraps it about a cylinder of material capable of becoming luminiferous by heat, whereby the filament acts as a heating medium for the luminiferous material.